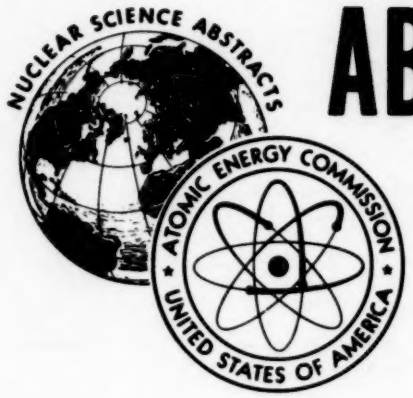
NUCLEAR SCIENCE ABSTRACTS



Volume 29 Number 12

Abstracts 28961-31666

June 30, 1974

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NOTICE

A title page for Volume 29, Numbers 7–12, is included at the back of this issue for use in binding those issues.

CORRECTIONS

NSA Vol. 21-28, Cumulative Report Number Index, page 334, COO-5000-20 should be: COO-2039-20.

NSA Vol. 21-28, Cumulative Report Number Index, page 836, WASH-1504 should have Abst. No. 17275 and WASH-1529(Dr.) should have Abst. No. 17247.

NSA Vol. 27, No. 8, Report No. Index, page 165, WASH-1504 should have Abst. No. 17275 and WASH-1529(Dr.) should have Abst. No. 17247.

NSA Vol. 28, No. 5, Abst. 12549, line 1 should read: (COO-2039-20) ELECTRONIC EXCITATION

NSA Vol. 29, No. 6, Abst. 12738, line 3 should read: K. J. (Kongelige Veterinaer- og Landbohoejskole, Copenhagen).

NSA Vol. 29, No. 7, Abst. 17219, line 22 should read: For title listings of selected sections see: 17177, 17204, 17220, and 17253. These same Abst. Numbers should be deleted from Abst. No. 17217.

Volume 29, Number 12, June 30, 1974

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director.
Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the USAEC Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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Cumulative Report Number Index, Vols. 21–26, $9.00.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

COX, S.H, DNA replication of induced prophage in Haemophilus influenzae, 28:18453
CRANDALL, J.L, Californium-252 neutron sources, 28:18415 (DP-MS-72-45)
CRAWFORD, J.F, Electron multiplication in cavities, 28:18990

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

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Institute of Nuclear Research two-year-book, 1970--1971, 28:19902 (INR--1410)
RED DWARF STARS/STAR EVOLUTION
Perturbing aspects of the companions of Barnard's star, 28:19287
REFRACTORIES/ELECTRON MICROSCOPY
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19981 (ORNL-4804) ^{238}U NEUTRON ELASTIC-SCATTERING CROSS SECTIONS FROM 6.44 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. **(Oak Ridge National Lab., Tenn.).** Jun 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
^{238}U neutron elastic-scattering cross sections from 6.44 to 8.56 MeV, 28:19981 (ORNL-4804)
Analytical techniques for determining levels and fates of trace elements in a fossil-fueled steam plant, 28:17850 (CONF-730817-1)

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Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Volume 29, Number 12 June 30, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 30070 and 31623.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 29962 and 30137.

28961 (AERE-R-7646) SOME APPLICATIONS AT HARWELL OF NONDESTRUCTIVE γ-PHOTON ACTIVATION ANALYSIS. Hislop, J. S. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1974. 19p. Dep. NTIS (U. S. Sales Only) $4.00. UK 50 pence.

γ activation offers a complementary technique to thermal neutron activation by making available an entirely different range of nuclear reactions for analytical purposes. Certain applications of γ photon activation at Harwell are described which illustrate how the technique can be used without the use of radiochemical separations. These include the determination of certain light elements using decay curve analysis of β^+ activity and the advantages and disadvantages of the method are discussed. Used in conjunction with high resolution γ ray spectrometry, γ activation has been applied to the analysis of a variety of materials of geological and environmental interest, emphasis being placed on elements not readily determined using thermal neutrons. An attempt has been made to place γ activation in perspective with regard to alternative analytical methods for such analyses. (auth)

28962 (BNL-18604) COMPOSITIONAL GROUPINGS OF SOME ANCIENT AEGINA AND EASTERN MEDITERRANEAN POTTERY. Bieber, A. M. Jr.; Brooks, D. W.; Harbottle, G.; Sayre, E. V. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 54p. (CONF-730575-9). Dep. NTIS $4.75.

From international conference on application of nuclear data in the field of work of art; Rome-Venice, Italy (24 May 1973).

A difficult but most important problem in archaelogy and art history is that of establishing the origins of the various artifacts under study. In the case of pottery, much work has been done in recent years using neutron activation analysis to establish trace element patterns which in optimum instances may be used to match pottery with the clay source from which it was manufactured. This paper gives some results of research carried out at Brookhaven National Laboratory involving neutron activation analysis of samples of pottery and clays from sources in Cyprus, the Aegean area, Palestine, and elsewhere in the Eastern Mediterranean, and the formation of groups of pottery specimens on the basis of these analyses. Some applications of multivariate methods to the problem of grouping the analytical data and some of the archaeological inferences which can be drawn from the data are also discussed. (auth)

28963 (BNL-18629) STUDY OF THE MATERIAL AND TECHNIQUES USED BY SOME NINETEENTH CENTURY AMERICAN OIL PAINTERS BY MEANS OF NEUTRON ACTIVATION AUTORADIOGRAPHY. Cotter, M. J.; Meyers, P.; van Zelst, L.; Olin, C. H.; Sayre, E. V. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 53p. (CONF-730575-10). Dep. NTIS $5.75.

From international conference on application of nuclear data in the field of work of art; Rome-Venice, Italy (24 May 1973).

Neutron activation autoradiography and activation analysis were used to study techniques and material used by nineteenth century painters particularly Ralph A. Blakelock. These techniques can supply information on pigments as well as the way they are applied. (LK)

28964 (BNL-18662) ANALYTICAL COMPARISON OF VARIOUS EGYPTIAN SOILS, CLAYS, SHALES, AND SOME ANCIENT POTTERY BY NEUTRON ACTIVATION. Tobia, S. K.; Sayre, E. V. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 35p. (CONF-730416-5). Dep. NTIS $3.75.

From second Cairo solid state conference; Cairo, United Arab Republic (21 Apr 1973).

Trace impurities in clays and shales in Egypt were investigated as a basis for classification of clays and for tracing the origin of the parent materials used in pottery manufacturing. Nine pottery specimens were analyzed as a very preliminary test of the potential of correlation between clay and pottery compositions. (LK)

28965 (CEA-CONF-2496) STUDY OF HEAVY METALS IN THE GRASS-MILK PRODUCT CHAIN BY MEANS OF NEUTRON ACTIVATION AND ATOMIC ABSORPTION. Bruant, C.; Bruant, J. P.; Neuburger, M.; Vassal, L.; Disant, C.; Bittel, R.; Fourcy, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1973. 18p. (In French). (CONF-730817-5). Dep. NTIS (U.S. Sales Only) $3.00.

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973).

The contamination of the grass-ruminant-milk product food chain with the heavy metals Hg, Cu, Zn, Pb, and Cd is studied. The first three metals were determined by neutron activation and the last two by atomic absorption spectrophotometry. The chemical nature of these metals and their biological effect leads to different results from those obtained for the principal fission products. As a rule the heavy metal concentrations at harvest are much lower than that of the foods ingested by lactating cows. The cow plays the role of filter. If the concentration of these elements is considered in $\mu g/g$ of fresh material there is a reconcentration of these heavy metals in cream and cheese, probably connected with their physico-chemical affinity for proteins. (JSR)

28966 (FDA-73-8029, pp 450-454) MEASUREMENT OF CALCIUM IN THE LOWER LEGS BY NEUTRON ACTIVATION ANALYSIS USING α-n SOURCES. Agard, E. T. (Puerto Rico Nuclear Center, San Juan). Mar 1973.

In health physics in the healing arts.

28967 (FRNC-TH-468) DETERMINATION OF 11 RARE EARTH ELEMENTS IN VEGETATION USING ACTIVATION ANALYSIS. Absorption of Tb by Excised Zea Mays Roots. Danne, R. (Grenoble-1 Univ., 38 (France)). 1970. 73p. (In French). Dep. NTIS (U. S. Sales Only) $6.75.

Thesis.

An activation analysis method sufficiently sensitive to detect traces of rare earth elements in vegetation was developed. Ion exchange resin (Dowex 50) chromatography using ammonium α-hydroxybutyrate as the eluant was employed to isolate each lanthanide. It was possible to separate 11 lanthanides. The absorption of a rare earth by excised zea mays roots was studied using a radioactive tracer, ^{159}Tb, this isotope transforming into ^{160}Tb under the action of neutrons. An apparatus was developed that automates the successive absorption phases. In order to interpret the absorption mechanism, the effects of certain factors were determined (temperature, pH, Ca^+ concentration, and 2,4 dinitrophenol). (FR)

28968 (INIS-mf-1014) DETERMINATION OF VANADIUM IN PETROLEUM AND RELATED PRODUCTS BY ACTIVATION ANALYSIS. Passaglia, A. M. (Sao Paulo Univ. (Brazil). Instituto de Quimica). 1972. 71p. (In Portuguese). INIS.

Thesis.

Vanadium at level of parts per million, in petroleum fractions and in silica alumina cracking catalyst was determined by activation analysis. Instrumental determination of vanadium in petroleum was made after 15 sec of irradiation and the activity of ^{52}V was measured by means of a NaI(Tl) scintillation detector. Vanadium in petroleum fractions was also determined using instrumental reactor-neutron activation analysis. The counting of activities was performed by means of a high resolution Ge(Li) gamma-ray spectrometer. The irradiation time was 5 min. For irradiation, crude and petroleum fractions samples were sealed in polyethylene containers. Radiochemical separation of vanadium in cracking catalyst was made by solvent extraction after 5 min of irradiation. Vanadium was extracted into chloroform with N-benzoyl-N-phenylhydroxilamine. A thermal neutron flux of about 5×10^{12} n/cm^2 sec was used for all irradiations. According to the results obtained, the analytical method of neutron activation is a specific, sensitive and precise method of analysis and adequate for routine analysis. (INIS)

28969 (KFK-1888) SIMULTANEOUS DETERMINATION OF ^{235}U AND ^{239}Pu TRACES BY GAMMA-SPECTROMETRIC ANALYSIS OF NOBLE FISSION GASES FOLLOWING NEUTRON ACTIVATION. Hawa, A. H.; von Baeckmann, A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). Jan 1974. 59p. (In German). Dep. NTIS (U. S. Sales Only) $6.00.

Thesis. Submitted by A. H. Hawa to Karlsruhe Univ. (West Germany). Faculty fuer Chemie.

A method is described which allows simultaneous and quantitative determination of ^{235}U and ^{239}Pu traces in the microgram range, using the fission of the two nuclides by thermal neutrons. The noble fission gases produced in this process are sorbed on activated charcoal shortly after irradiation, desorbed again after some time and the non-volatile daughter nuclides ^{88}Rb and ^{139}Cs are determined by gamma spectrometry. Their activities serve as a basis for direct calculation of the irradiated amounts of ^{235}U and ^{239}Pu. The method allows simultaneous or individual determination of ^{235}U and ^{239}Pu in the microgram range with an error of about 5%. Because of its simplicity, relative accuracy, freedom from failure, and rapidity, it is also an appropriate means of determining the two nuclides in highly active waste solutions from reprocessing plants. The presence of long-lived fission products does not interfere. In the course of the studies, the cumulative fission yields in ^{86}Kr and ^{136}Xe obtained during thermal fission were determined experimentally for the first time and amount to 3.09% and 5.28%, respectively, in the case of ^{235}U and to 1.08% and 4.32%, respectively, in the case of ^{239}Pu. (auth)

28970 (TLU-22-73) FAST METHOD FOR NITROGEN DETERMINATION IN SINGLE SEEDS. Sundqvist, B.; Goenczi, L.; Bergman, R.; Lindh, U. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Oct 1973. 12p. Dep. NTIS (U. S. Sales Only) $4.00.

(d,p) and (d,α) reactions in ^{14}N were used for determination of the nitrogen content in single kernels of seed. Due to the large positive Q-values of those reactions in ^{14}N compared to the corresponding reactions in ^{16}O and ^{12}C, it is possible to make a reliable and fast determination of the nitrogen content in the volume probed by the incident deuterons. In the present experiment 6-MeV deuterons were used. Single kernels of wheat and barely from Kjeldahl analyzed samples were analyzed with the present method and strong correlation was found. The possibility to achieve depth distributions is also demonstrated. (auth)

28971 MAGNETIC SPECTROMETER FOR NUCLEAR MICROANALYSIS OF CONCENTRATION DISTRIBUTIONS. Lindstrom, W. W.; Heuer, A. H. (Case Western Reserve Univ., Cleveland). Nucl. Instrum. Methods; 116: No. 1, 145-155(1974).

The construction and calibration of a magnetic spectrometer for studies of ^{18}O distributions within a solid sample using the $^{18}O(p,\alpha)^{15}N$ reaction is discussed. This approach allows probing deeper concentration profiles than does the present absorber-foil technique. A detailed description of the use of this spectrometer in nuclear microanalytical experiments is also given. (auth)

28972 MICROANALYSIS OF THE SURFACE REGION OF SOLIDS BY DIRECT OBSERVATION OF THE LOW-ENERGY NUCLEAR INTERACTIONS. Applications to Solid-State Electrochemistry, to Thin Layers, to Metallurgy, to Crystallography and to Biology. Amsel, G. (Univ., Paris). J. Radioanal. Chem.; 17: No. 1-2, 15-27(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The wide-scale applications of the microanalysis of surface regions of solids by direct observation of low-energy nuclear reactions are reviewed. These include nuclear reactions for light nuclei (^{14}N, ^{16}O, ^{18}O, ^{19}F, etc.) and elastic back scattering for the heavier nuclei. The review is illustrated by experiences of groups working in this area on the 2-MeV accelerator of the Ecole Normale Superieure. Studies on the microanalysis of elements such as O, N, and F are described. The possibilities offered by isotopic tracer techniques with ^{18}O for the study of the anode and thermal behavior of thin oxide films are emphasized. The regions illustrated cover solid-state electrochemistry, thin films, metallurgy, crystallography, and biology. 57 references. (tr-auth)

28973 ANALYSIS OF MICROQUANTITIES OF TRACE ELEMENTS IN SOLID SUBSTANCES BY ION BOMBARDMENT. Deconninck, G. (Facultes Univ., Namur, Belg.). J. Radioanal. Chem.; 17: No. 1-2, 29-43(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Bombardment by photons and α particles is used as a tool for trace analysis. The emissions detected are γ rays, x rays, and the back scattering of α particles. The sensitivities of these techniques and application examples are discussed. The examples given are the analysis of glass surfaces for B, Sn, and F, the analysis of Fe in gels, analysis of atmospheric pollution filters, analysis of heavy elements in plant fragments, and microanalysis of light elements in biological fragments. (JSR)

28974 ROLE OF ELASTIC SCATTERING ANALYSIS IN STUDIES OF ANODIC OXIDATION. Mackintosh, W. D. (Chalk River Nuclear Labs., Ont.). J. Radioanal. Chem.; 17: No. 1-2, 45-54 (1973).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Elastic scattering analysis can detect microquantities if they are concentrated in thin films. Moreover the method can furnish directly indications on the placement of these elements. These characteristics were applied profitably to an instrument used for the study of oxidation processes. The results obtained in the study of the anodic oxidation of Al using charged He^+ particles were reported. The metal and oxygen migration during oxidation and the behavior of foreign ions were studied. (JSR)

28975 MICROANALYTICAL USES OF SMALL-DIAMETER CHARGED-PARTICLE BEAMS. Pierce, T. B. (Atomic Energy Research Establishment, Harwell, Eng.). J. Radioanal. Chem.; 17: No. 1-2, 55-63(1973).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

It is often necessary to obtain analytical data on samples of small volume either to characterize qualitatively or quantitatively microquantities or to permit the study of local variations in composition. The charged particle flux produced by high voltage accelerators can be focused to diameters of several microns permitting numerous methods of charged particle activation methods to be applied to the analysis of small volumes. The analytical data can be deduced from the selective examination of radiations emitted during charged-particle irradiation. This can include elastic scattering, determination of the charged particles emitted, and γ and x emission. The local concentration variations of an element can be followed by sweeping the surface of a sample with an ion beam either by mechanical movement of the sample or by deflection of the beam. The microbeam techniques are used to obtain data on metallurgical, mineralogical, and semiconductor surfaces. The techniques used at Harwell and some typical results are discussed. (tr-auth)

28976 APPLICATION OF THE METHOD OF SURFACE DETERMINATION BY NUCLEAR REACTIONS FOR EVALUATION OF SURFACE–MASS INTERFERENCE. Quaglia, L.; Weber, G. (Univ., Sart Tilman, Liege). J. Radioanal. Chem.; 17: No. 1-2, 91-100(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

In a research program on the study of the different methods for the determination of oxygen in non-ferrous metals, the effect of surface oxygen on the determination of oxygen in the mass was examined. This surface analysis was accomplished by using nuclear reactions induced by low-energy charged particles obtained from a 2-MeV Van de Graaff accelerator. The metals studied were Al, Cu, Cu–Zn, Ti, Zr, Nb, Pb, Pb–Sb, Mo, and Ta. (JSR)

28977 APPLICATION OF SOME MICROANALYSIS METHODS TO THE STUDY OF PASSIVATION LAYERS IN STAINLESS STEEL. Revel, G. (CNRS, Vitry, France); Da Cunha Belo, M.;

Meriaux, J. P.; Schneider, C.; Hilleret, N.; Bourguiliot, R. J. Radioanal. Chem.; 17: No. 1-2, 101-111(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

In order to define more exactly the phenomena responsible for fissuring corrosion of stainless steel, the passivation films formed on the surface of samples exposed to boiling $MgCl_2$ was studied. The thickness of these films varies from several hundred to several thousand Å according to the duration of the treatment. The analysis methods used are neutron and charged particle activation, secondary ion emission, and atomic ionoluminescence. The results obtained are described and compared with each other. (tr-auth)

28978 APPLICATION OF INORGANIC EXCHANGERS TO RADIOCHEMICAL SEPARATIONS ON NEUTRON-ACTIVATED HIGH-PURITY MATERIALS. Cuypers, J.; Girardi, F.; Mousty, F. (Joint Nuclear Research Center, Ispra, Italy). J. Radioanal. Chem.; 17: No. 1-2, 115-125(1973).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The use of inorganic exchangers in the destructive analysis of high-purity materials and particularly for the systematic determination of a large number of elements is described. Recent improvements in the method, which permit a mathematical evaluation of the radiochemical separation modes on inorganic exchangers are briefly summarized. The separation modes in the case of the determination of impurities in high-purity Al and Zn are described. Results for several Zn samples obtained by successive purifications are given. These results show the evolution of the distribution of different impurities. The results obtained in the case of a Zn sample used as a standard are also given. (tr-auth)

28979 ACTIVATION ANALYSIS AT THE SCHOOL OF MINES IN SAINT-ETIENNE: APPLICATION TO THE STUDY OF VERY HIGH PURITY IRON. Lesbats, A.; Tardy, M. R. (Ecole Nationale Superieure des Mines, Saint-Etienne, France). J. Radioanal. Chem.; 17: No. 1-2, 127-137(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Within the framework of studies made at the Ecole Nationale Superieure of the Mines of Saint-Etienne on high-purity metals, it was necessary to know with precision the concentration of each element impurity in these metals. It is shown how a laboratory remote from an atomic center can use radioactivation analysis. The principal application was the analysis of very pure Fe. A new simple rapid method was developed for this analysis. The method uses extraction with butyl acetate which allows a selective and quantitative separation of the Fe matrix. (tr-auth)

28980 AUTOMATION OF THE SYSTEMATIC ANALYSIS SCHEME FOR HIGH PURITY IRON. Cleyrergue, C.; Deschamps, N. (CNRS, Gif-sur-Yvette, France). J. Radioanal. Chem.; 17: No. 1-2, 139-151(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The necessity of simplifying the analysis of Fe led to the study of the fixation of Fe on tin dioxide as a function of the temperature and nitric acid concentration and to the measurement of the fixation capacity of tin dioxide for Fe. These results were applied to the study of an analysis scheme for Fe. After a description of the chemical operations the programming principles are reviewed. The scheme contains 5 fractions. It is possible to determine about 15 elements in Fe. The automatic part of the scheme takes 40 min. and it is possible for one person to make 5 analyses in 2 days. (tr-auth)

28981 SYSTEMATIC ANALYSIS OF TRACE ELEMENTS IN METALLIC GOLD BY NEUTRON ACTIVATION. May, S.; Piccot, D.; Pinte, G. (CEN de Saclay, Gif-sur-Yvette, France). J. Radioanal. Chem.; 17: No. 1-2, 153-166(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

An analytical method for impurities in metallic Au by neutron activation was developed. After 15-hr. irradiation in a flux of 2×10^{14} n/cm^2/sec the Au sample is processed in a shielded cell. The matrix is separated from the impurities into 3 fractions which are measured by γ spectrometry. The data processing is made on an IBM 360/91 computer with a program written in the laboratory. Twenty-nine elements are detectable by this method. (tr-auth)

28982 SYSTEMATIC ANALYSIS OF CERIUM BY NEUTRON ACTIVATION. Rouchard, J. C.; Revel, G. (CECM, Vitry, France). J. Radioanal. Chem.; 17: No. 1-2, 167-172(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Neutron irradiation of Ce produces significant radiation and chemical separations are necessary. An ion change method in tartaric acid was developed and about 20 elements can be determined with it. The use of a Ge-Li junction detector simplifies these separations considerably. (tr-auth)

28983 NEUTRON ACTIVATION DETERMINATION OF IMPURITIES IN VERY PURE SILVER WITH SEPARATION OF THE ELEMENTS BY EXTRACTION. Artyukhin, P. I.; Startseva, E. A.; Nikolaev, A. V. (Committee on Atomic Energy, Moscow). J. Radioanal. Chem.; 17: No. 1-2, 173-183(1973). (In Russian).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

A neutron activation method was developed for 24 microimpurities in Ag. In order to eliminate the matrix and to separate the impurities extraction was used. The shielding effect of the Ag samples on the neutron flux was evaluated theoretically and experimentally verified. (tr-auth)

28984 APPLICATION OF A SEMI-CONDUCTOR IN THE SYSTEMATIC ANALYSIS OF ALUMINIUM. Blouri, J.; Fedoroff, M.; Revel, G. (CECM, Vitry, France). J. Radioanal. Chem.; 17: No. 1-2, 185-194(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

After neutron irradiation for 7 days in a flux of 3×10^{12} n/cm^2/sec about thirty elements can be determined without chemical separation in Al samples of various origin. The measurement and calculation procedures of the radioactivities are defined and the detection limits are indicated. The limits are between 5×10^{-2} and 5×10^{-4} μg/g according to the element being determined. For some elements (Fe, Zn, and Zr) these limits can be improved by a simple chemical separation. (tr-auth)

28985 DETERMINATION OF TRACE-ELEMENT IMPURITIES IN NATURAL DIAMONDS BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Fesq, H. W. (Univ. of Witwatersrand, Johannesburg); Bibby, D. M.; Sellschop, J. P. F.; Watterson, J. I. W. J. Radioanal. Chem.; 17: No. 1-2, 195-216(1973).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The non-destruction neutron activation analysis was applied to determine trace impurities in diamonds. A high-resolution Ge(Li) detector was used. The presence of 40 elements in natural diamonds is shown. Quantitative results are given for 13 elements in 25 representative diamond samples of the same origin. A relation is established between the chemistry of the inclusions and the color of the diamonds on one side and the element traces found on the other. (tr-auth)

28986 DETERMINATION OF SILICON IN REFINED ALUMINUM BY THERMAL NEUTRON IRRADIATION AND SEPARATION OF THE SILICA BY PRECIPITATION. Beyssier, B.; Angella, Y. (Centre de Recherches, Voreppe, France). J. Radioanal. Chem.; 17: No. 1-2, 219-228(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The reaction $^{30}Si(n,\gamma)^{31}Si$ (2.6 hrs.) is sufficiently sensitive to allow the determination of the Si present in very low concentrations in a material. The fact that the usable radiation is a β^-, a very selective chemical separation of Si, requiring a sufficiently short time lag, is necessary. The separation methods usually used for the determination of Si traces, extraction of the silicomolybdic complex and distillation of the fluosilicic acid, do not give reliable results. The precipitation method, after addition to the samples and standards of an exactly known mass of silica in solution, was used. Because the precipitation yield is established with precision by simple weighing, the reaction does not have to be quantitative. The precipitate is purified by double precipitation and its purity determined by γ spectrometry. After redissolution in HF at a temperature of 5°C in order to avoid Si losses, counting is done in a mylar capsule placed on the counter. The counting reproducibility is excellent and the activity of the boundary layer is measured. The standards of quartz wool are treated in the same fashion as the samples. Experience showed that the chemical interferences are negligible. On the contrary a very good thermalization of the neutron flux is indispensable because of the reactions $^{31}P(n,p)^{31}Si$ and $^{34}S(n,\alpha)^{31}Si$. Taking into consideration the P and S concentrations in the refined Al and the neutron flux characteristics during the irradiation the determination limit is 3 ± 0.5 μg/g. The results made it possible to obtain precise calibration slope for emission spectrography. One person can process 6 samples and 2 standards in one 8-hr. day. (tr-auth)

28987 NEUTRON ACTIVATION ANALYSIS OF STEEL FOR SUB ppM AMOUNTS OF LANTHANUM AND GOLD WITHOUT DETERMINING THE CHEMICAL YIELD. Foldzinska, A.; Dybczynski, R. (Inst. of Nuclear Research, Warsaw). J. Radioanal. Chem.; 17: No. 1-2, 229-236(1973).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

A neutron activation method was developed for the determination of La and Au in quantities below ppM in steel without determination of the chemical yield. The method consists in the quantitative isolation of the La and Au activities by ion exchange procedures followed by NaI(Tl) spectrometry. The detection limit is lowered to 10 and 5 ppB respectively for La and Au. There is practically no interference from the other elements usually present in steel. (tr-auth)

28988 DETERMINATION OF ARSENIC, SELENIUM, AND TELLURIUM IN ELEMENTARY SULFUR. Verot, J. L.; Jaumier, J. J. (Laboratoire Central de Recherches Produits Chimiques Ugine Kuhlmann, Ldevallois Perret, France). J. Radioanal. Chem.; 17: No. 1-2, 237-240(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

These three elements and particularly As are poisons for the catalysts for the oxidation of sulfur dioxide into sulfur trioxide. Activation analysis makes it possible to determine these three elements simultaneously. After irradiation the S is placed in solution in the presence of sodium carbonate and carbon disulfide. The analysis is made instrumentally when the As, Se, and Te concentrations are higher than 1 ppM. For smaller concentration chemical separation with the addition of carriers is carried out. (tr-auth)

28989 DETERMINATION OF CARBON AND OXYGEN IN SODIUM AND CESIUM BY ACTIVATION BY MEANS OF GAMMA PHOTONS. Nordmann, F. (Ecole Superieure de Chimie, Mulhouse, France); Tinelli, G.; Engelmann, C. J. Radioanal. Chem.; 17: No. 1-2, 255-273(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The methods developed to determine very low concentrations of C and O in Na or Cs are developed. These two elements can be determined by the reactions $^{12}C(\gamma,n)^{11}C$ and $^{16}O(\gamma,n)^{15}O$. The chemical separation procedures used to separate ^{11}C and ^{15}O are described. The effect of competitive nuclear reactions producing these same isotopes from other impurities or from the matrix in the case of Na is discussed. Numerous application examples are given. These methods allowed the determination of O concentrations of several 10^{-1} $\mu g/g$ and C concentrations of about 1 $\mu g/g$ in Na. The concentrations found in Cs are higher. The results are compared with those obtained by other methods. (tr-auth)

28990 DETERMINATION OF O AND N IN ALKALINE METALS AND O IN OTHER METALS BY THE γ-ACTIVATION METHOD WITH CHEMICAL SEPARATION OF SHORT-LIVED ISOTOPES. Chapyzhnikov, B. A.; Malikova, E. D.; Kunin, L. L.; Samosyuk, V. N.; Vasserman, A. M.; Frolov, E. V.; Evganov, K. N. (Committee on Atomic Energy, Moscow). J. Radioanal. Chem.; 17: No. 1-2, 275-290(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

A method was developed for the rapid separation of the short-lived isotopes ^{15}O and ^{13}N in alkali metals and ^{15}O in other metals during the γ activation determination of O and N. The alkali metals were Li and Na and the other metals were steel, Cu, and In. (JSR)

28991 NONDESTRUCTIVE ANALYSIS OF IMPURITIES IN Ag, Al, AND Co BY UTILIZING ACTIVATION WITH 11-MeV PROTONS. Debrun, J. L.; Barrandon, J. N. (CEN, Saclay, Gif-sur-Yvette, France). J. Radioanal. Chem.; 17: No. 1-2, 291-299(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Activation with 11-MeV protons makes possible the nondestructive determination of trace impurities in samples of Ag, Al, and Co. The determination of 30 elements in Al and Co and 24 in Ag was studied. Protons were chosen because these particles are the only ones which allow a nondestructive determination in Ag and Co at the level of traces without interference. The case of Al was studied although neutrons can be used because proton activation allows the easy determination of elements other than those determined in neutron irradiation. (tr-auth)

28992 DETERMINATION OF OXYGEN IN ALUMINUM. Vialatte, B. (CEN de Saclay, Gif-sur-Yvette, France). J. Radioanal. Chem.; 17: No. 1-2, 301-312(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Activation analysis using protons, helions-4, helions-3, and photons was used to determine O in Al. A comparison of the results obtained with the different particles is possible. It appears that helion-3 activation is the most suitable for the determination of O in Al, which, whatever the purity of the samples analyzed, is very low. (tr-auth)

28993 ANALYSIS OF THIN LAYERS OF CHALCOGENIDE GLASS BY ELASTIC SCATTERING OF PROTONS AND MEASUREMENT OF THE PROMPT GAMMAS. Cohen, M.; Porte, L.; Thomas, J. P.; Tousset, J. (Univ., Claude Bernard, Lyon). J. Radioanal. Chem.; 17: No. 1-2, 65-77(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

A method for study of the stoichiometric composition of thin layers (10 to 500 $\mu g/cm^2$) of chalcogenide glasses was developed. The study of nuclear reactions induced by bombardment with low-energy protons (<4 MeV) on the constituent elements Ge, As, Te, and S led to the selection of elastic scattering and detection of prompt gammas for the simultaneous determination. The precision and sensitivity of the method are discussed from the results obtained. The use of the fine resonance on $S(p,p'\gamma)$ is applied to the study of the homogeneity of the targets. (tr-auth)

28994 DETERMINATION OF O, N, AND C IMPURITIES IN PURE MATERIALS BY THE METHOD OF ACTIVATION WITH FAST NEUTRONS AND γ QUANTA. Pronman, I. M.; Andreev, A. V.; Karpov, Yu. A.; Kudinov, B. S. (Committee on Atomic Energy, Moscow). J. Radioanal. Chem.; 17: No. 1-2, 243-254(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Methods for the determination of O, N, and C by neutron and γ activation are described. The emphasis was on avoiding the effect of surface contaminants and controlling the efficiency of the separation of the isotopes ^{15}O, ^{13}N, and ^{11}C. The materials were subjected to a chemical cleaning after irradiation. O was determined in V, Ni, Nb, and Ta; N in Si and Ge; and C in Si, Ge, GaAs, and GaP. (JSR)

28995 TRACE ANALYSIS BY SIMULTANEOUS UTILIZATION OF IONIC ABRASION AND THE NUCLEAR REACTION TECHNIQUE. Bruel, M.; Boissier, M.; Ligeon, E. (CEN, Grenoble, France). J. Radioanal. Chem.; 17: No. 1-2, 79-90(1973). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

A low-energy ion beam (ionic abraser) is associated with a microanalysis installation for direct observation of nuclear reactions. The system allows concentration profiles to be traced by abrasion counting. The results obtained concern (a) the measurement of the impurity profiles (B and P) in Si and ZnTe and (b) the study of the diffusion of oxygen under a neutron flux in Nb and Ni. (tr-auth)

28996 DISTRIBUTION OF SOME MICROELEMENTS IN SELECTED HEN TISSUES. Decowski, M. Pol. Arch. Wet.; 15: 137-143(1972). (In Polish).

The gamma radiation spectrum of some microelements in different tissues of 20 hens was investigated. The following organs were used in the tests: the chest and femoral muscles, stomach, liver, head, neck, wing, sternum and femoral bones. Radioelements were obtained by irradiation of incinerated hen tissues with a termic neutron flux and thus the elements present in hen tissues became radioactive. Zinc (^{65}Zn) was found in all the tested tissues, which confirmed its important role in the physiology of animal organism. Zinc was present in the greatest amount in the stomach, liver and femoral muscles, cesium (^{134}Cs) in the stomach, and femoral and chest muscles, and cobalt (^{60}Co) in the liver and stomach. (auth)

28997 NONDESTRUCTIVE ACTIVATION ANALYSIS IN BIOLOGICAL MATERIAL BY HIGH ENERGY PHOTONS. Pfeiffer, W. C.; Franca, E. P. (Univ., Rio de Janeiro). Cienc. Cult. (Sao Paulo); 25: No. 2, 141-146(Feb 1973). (In Portuguese).

The possibilities of employing high energy photons for activation analysis in biological material, without chemical treatment is evaluated and constituents of biological material that can be determined by this process are identified. As a nondestructive method, activation analysis presents advantages in comparison with conventional processes, allowing several analyses of the same samples, preservation of valuable samples, and high sensitivity. Employing 18-MeV photons it was possible to determine N, F, and Sr in biological materials with good accuracy, without chemical treatment, since nuclear reactions induced

by high-energy photons present different energy thresholds, thus avoiding the interference of macroconstituents by choosing the right photon energy. The determination of fluorine and strontium by colorimetric and atomic absorption methods produced good agreement with the results of activation analysis, whose sensitivities ranged 1 to 5 ppM for fluorine and 0.1 to 1 ppM for strontium. Determinations of fluorine and strontium were performed in teeth and bones of the same subjects, confirming published results that fluorine content varies between teeth and is higher at their surface. In different Brazilian areas the content of fluorine and strontium in teeth ranged from 0.05 to 0.13 mg/g and from 0.20 to 0.47 mg/g, respectively, in agreement with results observed in other countries. The efforts to determine nitrogen in living biological materials were not successful, as tissues did not survive the high radiation dose (Krads). (INIS)

28998 INVESTIGATION OF THE SPECTROMETRY OF THE GAMMA RADIATION FROM THE INELASTIC SCATTERING OF FAST NEUTRONS FOR THE DETERMINATION OF A SILICON MODULUS. Andreev, V. K.; Barenbaum, A. A.; Egiazarov, B. G.; Sel'dyakov, Yu. P.; Yakubson, K. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 17, 95-105(1972). (In Russian).

The results of the determination of the ratio of Al and Si (Si modulus) of a large mass of aluminosilicate rocks by use of the spectrometry of γ radiation accompanying the inelastic scattering of 14-MeV neutrons were reported. The experiments carried out on a modulus, imitating the well measurement conditions, indicated the prospects for the use of the method for the determination of the Si modulus under naturally occurring conditions. This method, in comparison with the "two-source method" has a series of advantages: very high accuracy of the determination of the Si modulus, slight dependence on the hydrogen content, and practical independence on the Fe content. (tr-auth)

28999 DETERMINATION OF U, Th, AND OTHER ELEMENTS IN GEOLOGICAL SAMPLES BY NON-DESTRUCTIVE NEUTRON ACTIVATION ANALYSIS. Moucka, V.; Kucera, J. (Geological Survey of the Czechoslovak Uranium Industry, Pribram). ([nd]). vp. (In Czech).

From symposium on the mining Pribram in science and technique 1972; Pribram, Czechoslovakia (1972).

Possibilities are dealt with of a nondestructive analysis of mineralogical samples in view of the determination of uranium and thorium contents. INAA is characterized by an extremely high sensitivity for the determination of many trace and rare elements. 20 to 30 elements can be determined simultaneously when using a gamma spectrometer with a semiconductor detector having high resolving power. When irradiating a sample with thermal neutrons, the high sensitivity and selectivity of INAA can be made use of for the determination of very low concentrations of trace and rare elements or for an analysis of very small sample amounts. Basic terms and principles involved in INAA are explained, the questions of the sensitivity and selectivity of determination are discussed. The possibilities of determining approx. 25 elements are surveyed. The particularities and limitations of analyzing samples with a higher uranium content are discussed. A possible INAA application in mineralogical and geochemical investigation is outlined. (Nuclear Sci. Abstr. Czech.)

29000 MEASUREMENT OF LIGHT ELEMENT CONCENTRATION ($Z < 10$) USING CHARGED PARTICLE RADIOACTIVATION. Mignonsin, E. P. (Univ., Liege). Ind. At. Spatiales; 17: No. 4, 10-28(Jul 1973). (English and French).

The determination of light elements ($Z < 10$) is of great importance in the technology of pure materials principally because of their effect on the surface properties of pure metals and semiconductors. Extremely small concentrations of these elements (of the order of 1.10^{-2} and 1.10^{-4} micrograms) can be determined using radioactivation techniques with charged particles (protons, deuterons, tritons, and hellons). Such determinations can be effected equally well in the bulk of the sample or in its surface layers. The techniques involved are based on nuclear reactions, and elastic and inelastic scattering phenomena. The results obtained for different matrices are presented. (FR)

29001 ACTIVATION ANALYSIS AND X-RAY FLUORESCENCE ANALYSIS. Mamuro, T. (Radiation Center of Osaka Prefecture, Sakai, Japan); Nagatsuka, S. Genshiryoku Kogyo; 19: No. 10, 17-24(Oct 1973). (In Japanese).

Activation analysis (AA) and x-ray fluorescence analysis (XRF) are used for examination of environmental pollution. Objects being polluted are roughly classified into the following three groups: (1) atmospheric floating dusts: Membrane-filter is used for sampling with good results. It is possible to quantitize 36 kinds of elements by AA and 24 kinds of elements (including 9 kinds of elements difficult to be analyzed by AA method) by the XRF method (as exciting line source, combination of ^{55}Fe and ^{109}Cd are used) and up to 45 kinds of elements by the combined methods. (2) Trace elements in water: although exclusively dependent on the AA method, there are various problems in the preparation of analysis samples such as pre-treatment, chemical separation and the like. As an actual example, 30 kinds of elements from waste water of mining, and quantities of Cr, Cd, Zn in waste water from refuse-incinerating plant, amounts of various elements in rivers and drinking water are illustrated. (3) Miscellaneous: For quantitative analysis of animal and plant polluted materials, for example, quantitative analysis of organic Hg, Cd, and Hg, As in hair, and the like the AA method is effectively utilized. (JA)

29002 Zr/Hf AND Dy/Eu RATIOS IN ZIRCONS OF BASIC IGNEOUS ROCKS OF ALKALINE CONTINENTAL SERIES. Carbonnel, J. P. (Univ., Paris); Deschamps, N.; Jaffrezic, H. Chem. Geol.; 12: No. 4, 271-279(Dec 1973). (In French).

Non-destructive neutron-activation analysis of Zr and Hf in gem-zircons from undersaturated basic rocks of old shields: French Central Massif, Indochina, Madagascar, Atakor (Sahara). The Zr contents are close to the theoretical value in zircon; the Hf contents vary from 0.51 to 0.74%. Statistically the Hf averages are identical for the main deposits studied. The Zr/Hf ratio is 75 for the European and Asiatic deposits and 80 for the African shield. The Dy/Eu ratio has the same homogeneity in the main deposits. These values tend to sustain the following hypothesis: zircons occurred during an early paragenesis of undersaturated alkaline magmas. (auth)

29003 MULTIVARIATE PREDICTOR FOR TOTAL BODY CALCIUM IN MAN BASED ON ACTIVATION ANALYSIS. Cohn, S. H.; Shukla, K. K.; Ellis, K. J. (Brookhaven National Lab., Upton, NY). Int. J. Nucl. Med. Biol.; 1: No. 3, 131-134(Feb 1974).

A multivariate predictor employing height and total-body potassium (lean body mass) for estimation of total-body calcium is presented. The empirical relationship between these variables was derived in a study of 14 normal subjects analyzed by total-body neutron activation analysis. This relationship is as follows: for males: $Ca_E = 54.6\ H/\overline{K}$, for females: $Ca_E = 57.0\ H/\overline{K}$. This predictor was developed to provide a means of normalizing the body calcium data obtained for patients with various metabolic disorders. The ratios of measured total-body Ca to predicted total-body calcium were determined for 180 patients from 10 disease categories. The identification of skeletal abnormalities is a useful application of this technique in clinical studies. (auth)

29004 INFLUENCE OF THE NEUTRON AND γ ABSORPTION IN ACTIVATION ANALYSIS WITH 14-MeV NEUTRONS. Dudzus, T. (Bundesanstalt fuer Materialpruefung, Berlin). (1973). vp. (In German).

From 4th seminar on activation analysis of the Bundesanstalt fuer Materialpruefung; Berlin, Germany (11 Oct 1973).

In the activation analysis of oxygen in metals with 14 MeV neutrons, neutron-flux density variations require the simultaneous irradiation of a neutron-flux monitor. As to the irradiation geometry used here, the position of the monitor is in the neutron shadow of the sample. This calls for corrections for flux depression and gamma absorption with respect to the sample as well as the standard, which are calculated under simplified assumptions. (GE)

29005 FIELD NEUTRON-ACTIVATION PHOTOMETRY IN PROSPECTING AND EXPLORATION OF DEPOSITS OF FLUORITE, APATITE, PHOSPHORITE, AND NON-FERROUS AND RARE EARTH ORES. Gorbachev, A. N.; Karpunin, A. M.; Matukanis, L. F. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 11-18 of Yaderno-Fizicheskie Metody Issledovaniya pri Razvedke i Ekspluatatsii Mestorozhdeni Tsvetnykh, Redkikh i Ftoroso-derzhashchikh Poleznykh Iskopaemykh. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The bases of fluorimetric neutron activation surveying — a new, rapid field method of fixing fluorine diffusion haloes — are discussed. The method is based on measuring the intensity of the hard gamma radiation from the isotope ^{18}N formed on fast-neutron irradiation of the fluorine contained in the rock. For the survey, a serial gamma spectrometer and a polonium–beryllium neutron source with an activity of 10 curies are used. The radiation safety of the observer is ensured by control of the distance from the source. The sensitivity threshold of the method is 0.05% F. The survey was successfully carried out with the purpose of indicating deposits of fluorite, apatite, phosphorites, antimony and mercury, tin, beryllium, tungsten, and molybdenum in eastern Siberia, the Far East, and central Asia. (tr-auth)

29006 DEVELOPMENT AND USE OF NUCLEAR METHODS OF ANALYSIS OF RARE AND NON-FERROUS METALS. Ostrou-

mov, G. V.; Arkhipov, A. A.; Lyubimova, L. N.; Popova, A. A.; Salmin, Yu. P.; Sergeeva, T. V.; Tokareva, D. V.; Chernova, A. A.; Shiryaeva, M. B. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 5-10 of Yaderno-Fizicheskie Metody Issledovaniya pri Razvedke i Ekhspluatatsii Mestorozhdeni Tsvetnykh, Redkikh i Ftorosoderzhashchikh Poleznykh Iskopaemykh. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The need for improvement (increased sensitivity, decreased dispersion, and lower costs) in methods of analysis for rare and non-ferrous metals was investigated. It was found that nuclear-physics methods satisfy these needs, for example, neutron activation in a nuclear reactor and x-ray radiometry. The practical application of the methods is described, indications of their sensitivities are given, the scale and results of their use are described, and data on their economic efficiency are presented. (tr-auth)

29007 ALPHA ACTIVATION AND X-RAY RADIOMETRIC METHODS AND EQUIPMENT FOR DETERMINING BAUXITE. Yakubovich, A. L.; Kotsen, M. E.; Przhiyalgovskii, S. M.; Roshchina, I. A.; Usenkov, V. N. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 56-67 of Yaderno-Fizicheskie Metody Issledovaniya pri Razvedke i Ekhspluatatsii Mestorozhdeni Tsvetnykh, Redkikh i Ftorosoderzhashchikh Poleznykh Iskopaemykh. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The application of two nuclear-physics methods to analysis of bauxite samples was studied. Aluminum in the range from 2 to 100% Al_2O_3 was determined by alpha activation. The basic components of bauxite ores (Al, Si, Fe, Ti, and Ca) were determined by a roentgenometric method. A vacuum counter with a 4-channel analyzer was used. (tr-auth)

29008 SIMULTANEOUS DETERMINATION OF FLUORINE AND OXYGEN BY NONDESTRUCTIVE ACTIVATION ANALYSIS WITH 14 MeV NEUTRONS. Application of the Double Irradiation Technique. Goda, A.; Tsuruoka, Y.; Sumi, K. (Kawasaki Steel Corp., Chiba, Japan). Jap. Anal.; 23: No. 1, 63-73(Jan 1974). (In Japanese).

In the activation analysis of oxygen using $^{16}O(n,p)^{16}N$ reaction with 14-MeV neutrons the coexistence of fluorine in the sample seriously interferes with the oxygen analysis, owing to production of the same nuclides by $^{19}F(n,\alpha)^{16}N$ reaction. However, since there is a large difference between the threshold energies for the above-mentioned reactions (fluorine, 1.6 MeV; oxygen, 10.2 MeV), a double irradiation technique provides a means to discriminate between ^{16}N activities induced by both the reactions. As the result of application of the technique to $^{19}F(n,\alpha)^{16}N-^{16}O(n,p)^{16}N$ reaction system, the possibility of simultaneous determination of fluorine and oxygen was demonstrated. Analyses were made by means of 14-MeV neutrons produced by bombarding a tritium target with deuterons. In the double irradiation technique with 14-MeV neutrons, a neutron moderator is used in order to realize another irradiation position with different energy distribution. Fluorine and oxygen contents are evaluated by a mathematical treatment of the ^{16}N specific activities of the analyzed samples and of the standard ones after the double irradiation with and without the neutron moderator. The use of a compound moderator which is composed of polyethylene and copper proved to be more effective to improve the analytical precision than a moderator that is made of polyethylene only. As a preliminary experiment, synthetic samples prepared with sodium oxalate and sodium fluoride were analyzed, and the analytical results for the elements in those samples were in good agreement with the calculated values. Then, various samples such as other fluorides, slags and fluor spars were analyzed, and successful results were also obtained. The analytical precision of the method depends especially on the mass ratio of fluorine to oxygen, m_f/m_o. The method is useful in the determination of fluorine and/or oxygen above ca. 1% in materials which do not contain many boron impurities. Compared with the chemical analysis, it is rapid and nondestructive and one sample can be analyzed within 15 minutes in the case of 3 measurements. The double irradiation technique is very promising to avoid the mutual interference between fluorine and oxygen in neutron activation analysis. (auth)

29009 ACTIVATION ANALYSIS BASED ON THE CHARACTERISTIC X RADIATION OF RADIOISOTOPES USING DIFFERENTIAL FILTERS. Zaitsev, E. I.; Sotskov, Yu. P. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 19-33 of Yaderno-Fizicheskie Metody Issledovaniya pri Razvedke i Ekhspluatatsii Mestorozhdeni Tsvetnykh, Redkikh i Ftorosoderzhashchikh Poleznykh Iskopaemykh. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

An instrumental method for activation analysis is proposed, based on selective measurements of the characteristic soft x radiation of activation products, using differential filters. The possibility of determining, from the long-lived isotopes, around 20 rare and dispersed elements was shown. The high efficiency of the method for quantitative determination of a number of elements with a sensitivity of about 10^{-4} to 10^{-5} % was demonstrated experimentally. (tr-auth)

Chemical and Spectral Procedures

Refer also to abstracts 29124, 29177, and 31624.

29010 (INIS-mf-1217) SPECTROCHEMICAL DETERMINATION OF RARE EARTH ELEMENTS IN URANIUM COMPOUNDS AFTER CHROMATOGRAPHIC SEPARATION FROM HYDROFLUORIC ACID ON ALUMINA. Lordello, A. R. (Sao Paulo Univ. (Brazil). Instituto de Quimica). 1972. 55p. (In Portuguese). INIS.

Thesis.

A method is presented for the determination of 14 rare earth elements in high-purity uranium compounds by emission spectrography. The rare earth elements are chromatographically separated from uranium by using alumina-hydrofluoric acid. Lanthanum is used both as collector and internal standard. The technique of excitation involves a total consumption of the sample in a 17-ampere direct current arc. The range of determination is about 0.005 to 0.5 μg/g uranium. The coefficient of variation for Pr, Ho, Dy, Er, Tm, Lu, Gd, and Tb amounts to 10%. (INIS)

29011 (LA-UR-74-356) EFFECT OF PARTICLE SIZE ON THE CARRIER-DISTILLATION ANALYSIS OF PuO_2. Martell, C. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 22p. (CONF-740314-1). DEP. NTIS $3.25.

From 25th Pittsburgh conference on analytical chemistry and applied spectroscopy; Cleveland, Ohio, USA (4 Mar 1974).

A study was made to determine the effect of particle size on the carrier-distillation analysis of PuO_2 and to explain how to avoid the difficulties caused by large PuO_2 particles. The relative intensity of five elements was determined for three particle sizes and it was shown that it increases as the particle size becomes smaller. Further the line intensity of the added internal standard Co also increased with decreasing particle size. Accurate spectrochemical results were obtained when the PuO_2 particle size was reduced to 45 μm or less. (JSR)

29012 (ORNL-TM-4370, pp 2-141) FAST ANALYZER DEVELOPMENT. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973-August 31, 1973. Part I.

New applications for the fluorimetric centrifugal fast analyzer include: (1) a technique for dynamic calibration in order to equate the fluorescent signal with the concentration of the analyte; (2) a kinetic method for determination of acid phosphatase; (3) a competitive binding assay for insulin using fluorescein-tagged insulin; and (4) a method for fluorimetrically measuring uranium. (LK)

29013 (Y-1937) IN-SITU CHARACTERIZATION OF COMMON IMPURITIES IN URANIUM METAL BY SPARK SPECTROCHEMISTRY. King, H. G. (Oak Ridge Y-12 Plant, Tenn. (USA)). 29 Mar 1974. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

A rapid spectrochemical method, involving the application of a condensed spark to finished or semifinished uranium metal surfaces, was developed to analyze large numbers of parts (50 or more in a single day) for up to nine specification impurity elements. No sampling or preparation is required, and the on-site analysis is carried out by transporting the spectrograph and source to the production area. The procedure is used for process control and is supplemental to the more refined pyro carrier spectrochemical analysis used for product certification. Elements determined by the large quartz prism spectrograph include: copper, iron, molybdenum, nickel, niobium, titanium, silicon, and zirconium. Carbon is determined by a very slight change in procedure. (auth)

29014 COMPARATIVE STUDY OF THE SULFOPHTHALEINS AS COMPLEXOMETRIC INDICATORS FOR ZIRCONIUM. Zadumina, E. A.; Arzamastseva, S. F. (Saratov State Pedagogical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 11, 1641-1643(1973). (In Russian).

A medium 0.5 to 2.0 N in HCl was found to be optimum for titrating a 0.02 M Zr solution with a series of sulfophthaleins such as: thymolsulfophthalein-s (Reagent A) [3,3'-bis-di(carboxymethyl)aminomethylthymosulfophthalein], n-xylolsulfophthlein-s (Reagent B), sulfophthalein-s (Reagent C), o-bromosulfophthalein-s and m-cresolsulfophthalein-s. The absorption spectra of the reagents and their zirconium complexes were taken

on a spectrophotometer. The titration efficiency was judged on the sharpness of the color contrast at the endpoint, the difference between the negative log of the equilibrium constant (pK) of the Zr complex with complexone III and pK' of the complex involving the reagent under test, and the molar extinction coefficients of the reagents and their Zr complexes. Reagents A, B, and C proved to be the most favorable ones for Zr determination. Reagents A and B showed a sharp transition from blue to yellow at the equivalence point, while Reagent C showed a color transition from red to yellow. Titration of Zr with these reagents is not affected by large amounts of rare earths, UO_2^{2+} and Cu^{+2}, or by moderate amounts of Th^{4+}, Sc^{3+} and Ni^{2+}. The ions Hf^{4+}, Fe^{3+}, F^-, $C_2O_4^{2-}$ and PO_4^{3-} interfere with Zr analysis. The error with these reagents is <1%. (SJR)

29015 DETERMINATION OF TANTALUM IN METALLIC NIOBIUM AND FERRONIOBIUM. Zaboeva, M. I.; Freidenzon, L. N.; Shishkina, N. I. (Ural State Univ., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 2, 183-186(1974). (In Russian).

The analysis is carried out by weighing 0.1 g ferroniobium (or metallic niobium), dissolving in a platinum disk in 3 ml HF (d = 1.15), 2 ml HNO_3 (d = 1.42) and 5 ml H_2SO_4 (d = 1.84), and heating until fumes of sulfuric acid appear. The solution is cooled, 4.0 g ammonium oxalate is added, and the solution is allowed to stand in a warm place 7-10 min. The contents of platinum disk are diluted to 100 ml with water, and allowed to stand at room temperature 10 to 12 hours. Depolymerization of polymeric tantalum compounds takes place on standing of the oxalate solution so that good reproducibility is obtained. A volume of 5-10 ml is taken, diluted to 10 ml with a 4% ammonium oxalate solution with addition of 6 ml of a saturated solution of sodium fluoride, and 2 drops of a 0.01% solution of crystalline violet, and the solution is neutralized to a blue color with NH_4OH (1:4) and H_2SO_4 (1:4), or to a pH of 1.5-2.0 according to universal indicator paper. The solution is transferred to a polyethylene vessel and then additions are made of 2.5 ml of a 0.2% solution of crystalline violet and 20 ml benzene. After 30 seconds agitation the benzene layer is separated and poured into a 50 ml flask containing 2 ml acetone. The flask is covered with a stopper and after 10-15 minutes the color is measured photometrically in a cuvette with l = 20 mm at λ = 610 mm. The tantalum content is found from a calibration curve determined by dissolving metallic tantalum in an acid mixture similar to that used with ferroniobium samples. The sensitivity of the method is 0.02%. The average error is ±3%. (SJR)

29016 PHOTOMETRIC TITRATION OF BERYLLIUM(II) WITH 5-SULFOSALICYLIC ACID. den Boef, G.; van der Linden, W. E.; Saad, N. M. (Univ. of Amsterdam). Anal. Chim. Acta; 69: No. 2, 469-472(Apr 1974).

Complexiметric titration of beryllium(II) with 5-sulfosalicylic acid is described. The end-point is determined with a spectrophotometer. (LK)

29017 SIMULTANEOUS MULTI-ELEMENT ATOMIC EMISSION FLAME SPECTROMETRY WITH AN IMAGE VIDICON DETECTOR. Knapp, D. O.; Omenetto, N.; Hart, L. P.; Plankey, F. W.; Winefordner, J. D. (Univ. of Florida, Gainesville). Anal. Chim. Acta; 69: No. 2, 455-460(Apr 1974).

The silicon diode array vidicon camera tube and the nitrous oxide-acetylene flame were used to determine limits of detection for Co, Cu, Er, Ev, Ho, In, Mn, Ni, Sc, Sr, and Yb. (LK)

29018 DETERMINATION OF STRONTIUM IN HUMAN TOOTH ENAMEL BY ATOMIC ABSORPTION SPECTROMETRY. Helsby, C. A. (Univ. of Manchester, Eng.). Anal. Chim. Acta.; 69: No. 2, 259-265(Apr 1974).

Interferences in the atomic absorption of strontium by calcium and phosphate at the levels found in human tooth enamel were investigated for both air-acetylene and nitrous oxide-acetylene flames. In air-acetylene flames, the interferences can be reduced by the addition of lanthanum(III); but perchloric acid, used for sample dissolution, causes a significant reduction in the calcium-phosphate interference, so that a standard addition method can be applied, without the need for any chemical separations. An average recovery of 98.6% for added amounts of strontium to enamel showed the proposed method to be reliable. (auth)

29019 INTERFERENCE BY ACIDS IN THE DETERMINATION OF MOLYBDENUM BY ATOMIC ABSORPTION SPECTROMETRY. Dilli, S.; Gawne, K. M.; Ocago, G. W. (Univ. of New South Wales, Kensington, Australia). Anal. Chim. Acta; 69: No. 2, 287-294 (Apr 1974).

The nature of the acid environment in the determination of molybdenum by atomic absorption spectrometry is shown to be of considerable importance. The most favorable conditions are provided by dilute hydrochloric acid and especially nitric acid. Sulfuric and phosphoric acids are not recommended because of their marked but opposite effects. The air-acetylene flame gives more reproducible results than the nitrous oxide-acetylene flame. (auth)

29020 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM(VI) WITH 2-MERCAPTOBENZO-γ-THIOPYRONE AND AMMONIUM THIOCYANATE. Savariar, C. P.; Arunachalam, M. K.; Hariharan, T. R. (Univ. of Calicut, Kerala, India). Anal. Chim. Acta; 69: No. 2, 305-311(Apr 1974).

Molybdenum(VI) in 1.4-3.6 M hydrochloric acid medium forms an acetophenone-extractable orange-red complex with the potassium salt of 2-mercaptobenzo-γ-thiopyrone and ammonium thiocyanate in the presence of tin(II) chloride. The limit of identification of the spot test based on this reaction is 0.1 μg of molybdenum (dilution limit, $1:1\cdot10^6$). The spectrophotometric method is fairly selective, the sensitivity being 0.005 μg Mo cm^{-2} at 470 nm. The color system obeys Beer's law; the optimal concentration range is 0.75-8.5 μg Mo ml^{-1}, the relative photometric error being 1.675%. The complex is stable for over 24 h. Common ions can be tolerated in amounts greater than 1000-fold. Interferences of Co^{2+}, Ni^{2+}, Cu^{2+}, and Ag^+ are avoided by complexing these ions with 2-mercaptobenzo-γ-thiopyrone at pH 6-10 and extracting with ethyl acetate or chloroform. The proposed method is applied to the determination of molybdenum in steel and in artificial mixtures. (auth)

29021 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM IN ROCKS WITH THIOCYANATE. Lillie, L. G.; Greenland, L. P. (Geological Survey, Washington, DC). Anal. Chim. Acta; 69: No. 2, 313-320(Apr 1974).

A rapid procedure for the determination of microgram amounts of molybdenum in rocks is described. After acid decomposition, molybdenum is extracted from a hydrochloric acid solution into xylene with tributyl phosphate. After back-extraction with water, molybdenum is extracted as the α-benzoinoximate into chloroform, stripped into hydrochloric acid, extracted as the thiocyanate into amyl alcohol, and determined spectrophotometrically. The molybdenum thiocyanate color produced is stable, sensitive, and reproducible. Results of analyses of several of the U. S. Geological Survey standard rocks are given. (auth)

29022 SPECTROPHOTOMETRIC DETERMINATION OF ANIONS BY SOLVENT EXTRACTION WITH METAL CHELATE CATIONS. Part L. Spectrophotometric Determination of Iodide by Solvent Extraction as bis(neocuproine)copper(I) Tri-Iodide. Yamamoto, Y.; Kumamaru, T.; Hayashi, Y.; Yamamoto, M. (Hiroshima Univ.). Anal. Chim. Acta; 69: No. 2, 321-328(Apr 1974).

A spectrophotometric method is proposed for the determination of small amounts of iodide. The method is based on the reduction of bis(neocuproine)copper(II) to the monovalent copper chelate cation in the aqueous phase by iodide ion and subsequent solvent extraction into chlorobenzene of the ion-pair formed between bis(neocuproine)copper(I) cation and the tri-iodide anion. At least a 5-fold molar amount of the copper(II) chelate cation, relative to iodide, is needed, and the optimal pH range is 3 to 5. The absorbance of the extract at 370 nm is a linear function of iodide concentration in the aqueous phase over the range $5\cdot10^{-6}$-$4\cdot10^{-5}$ M (ca. 0.6-5 p.p.m.). The relative standard deviation was 1.0%. Large amounts of fluoride and chloride (2000-fold molar) and bromide (50-fold) did not appreciably affect the determination of iodide. The extraction mechanism is elucidated. (auth)

29023 COULOMETRIC TITRATIONS OF ORGANIC COMPOUNDS. Krivis, A. F. (Univ. of Akron, OH). Rev. Anal. Chem.; 1: No. 4, 293-331(1973).

The following subjects are discussed: constant current coulometry; titration efficiency; apparatus; titration end point detection by photometric methods, electrometric methods, and automation; continuous coulometric operation; and applications. Bromine, chlorine, iodine, titanium, chromium, cerium, and dithionite ion have been successful as redox titrants in organic systems. (131 references) (LK)

29024 GRAVIMETRIC AND POLAROGRAPHIC ANALYSIS OF SAMARIUM-NICKEL-SILICON ALLOYS. Marina, V. S.; Biletska, I. P. Visn. L'viv. Derzh. Univ., Ser. Khim.; No. 13, 21-25(1972). (In Ukrainian).

Procedures: (i) For Si-Dissolve the sample (0.03 to 0.05 g) in 10 ml of HCl (1:4) plus 5 ml of HNO_3, evaporate the soln., and to the residue add 20 ml of conc. HCl. After 5 min. add 25 ml of hot H_2O, heat to 60° to 70°, then filter off and wash the solids and determine the Si by the usual gravimetric method. (ii) For Sm and Ni-To the filtrate from procedure (i) add 20 ml of M-LiCl

in 15% methanol, and dilute to 200 ml. Adjust an aliquot to pH 5.0, and determine the Sm and Ni by polarography. (Referativnyi Zh.)

29025 DETERMINATION OF TITANIUM AND ZIRCONIUM IN MINERALS. Radil, V.; Milkusic, O.; Jaros, J. (Czechoslovak Uranium Industry, Zbraslav). ([nd]). vp. (In Czech).

From symposium on the mining Pribram in science and technique 1972; Pribram, Czechoslovakia (1972).

A spectrophotometric method was elaborated of determining titanium in the concentration range 0.002 to 1%. The determination is based on color reactions of titanium with diantipyrilmethane in 2.5 M HCl. The interfering elements are separated by extraction with tributylphosphate from 6 M HCl. An indirect chelatometric method was used for the determination of zirconium content above 1%. Chelaton surplus was determined in a weakly acid medium by titration with bismuth trinitrate using xylenol orange as an indicator. Iron was separated by extraction with methylisobutylketone from 6 M HCl. Subsequently, zirconium was re-extracted with tributylphosphate from 4 M HCl. A spectrophotometric method with xylenol orange was also developed for the determination of low concentrations of zirconium in 0.8 M HCl. Separation of zirconium from interfering elements is similar to the titration determination of zirconium. The method is suitable for analyzing minerals containing 0.002 to 0.8% of Zr. (Nuclear Sci. Abstr. Czech.)

29026 LUMINESCENCE DETERMINATION OF BERYLLIUM WITH 2-SALICYLIDENEAMINOBENZENEARSONIC ACID. Talipov, S. T.; Tashkhodzhaev, A. T.; Zel'tser, L. E.; Khikmatov, K. Nauch. Tr., Tashkent. Gos. Univ.; No. 419, 89-93(1972). (In Russian).

This compound is proposed as a reagent for the luminescence determination of Be in concentrations down to 0.9 mg per ml. There is no interference from at least a 100-fold excess of Al, Cu or Zn. (Referativnyi Zh.)

29027 DETERMINATION OF PLUTONIUM IN URINE. Popplewell, D. S.; Stradling, G. N. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 6, 18-20(Jan 1974).

An outline summary is given of an NRPB development of a new method of determining Pu in urine. The chemical manipulations take 2 to 3 h. It was known that quadrivalent Pu binds to transferrin in solutions of pH > 6. This serum protein, m.w. 88,000, was easily filtered from aqueous solutions with appropriate membranes, filtration time being decreased by the use of a membrane of larger pore size, an improvement being made on yields obtained by filtering off species normally present in Pu bearing urine. (UK)

29028 METALXANTHATES AND DITHIOCARBAMATES. Magee, R. J. (La Trobe Univ., Melbourne). Rev. Anal. Chem.; 1: No. 4, 333-377(1973).

Analytical uses of metal xanthates and dithiocarbamates are discussed. Preparation methods are given for alkali metal salts of dithiocarbamic acids and xanthic acids and for metal dithiocarbamates and xanthates. Spectrophotometric and electroanalytical methods for copper, silver, gold, alkali metals, zinc, cadmium, mercury, cobalt, palladium, rhodium, and nickel are reviewed. Photometric determination of thallium lead, and gallium is discussed. Determination of niobium, bismuth, tellurium, molybdenum, arsenic, and manganese by spectrophotometry is reviewed. (204 references) (LK)

29029 ANALYTICAL CHEMISTRY OF ACTINIDE ELEMENTS. Scherff, H. L. (Commission of the European Communities, Karlsruhe, Ger.). Chem. Ztg.; 97: No. 10, 548-556 (Oct 1973). (In German).

A general review of the field of analytical chemistry of the actinide elements is presented with special emphasis being given to technically important aspects of nuclear fuel analysis. Classical and instrumental chemical and radiochemical techniques for determination of these elements on the macro and tracer level are briefly discussed and illustrated by some examples, including analysis of trace impurities in actinide samples. Reference is also made to the specific problems arising during practical execution of actinide analysis typical for these elements, which are mainly due to their radioactivity. (auth)

29030 SPECTROGRAPHIC METHOD OF DETERMINATION OF NIOBIUM IN STEEL. Ghosh, M. K.; Gopalkrishna, S. V.; Chakrabarti, H. K. (NML, Jamshedpur, India). NML (Nat. Met. Lab.) Tech. J. (Jamshedpur, India); 13: No. 4, 100-103(1971).

Small amounts of niobium, both in mild steel and stainless steel, have been determined by an intermittent arc and point to plain spark technique respectively using secondary solid standards. Niobium in the range of 0.01 to 0.2% in mild steel and 0.1 to 1.0% in stainless steel was determined by this method with reproducible results having good agreement with chemical results. (Indian Sci. Abstr.)

29031 EQUILIBRIA IN ALKALINE NIOBIUM(V) SOLUTIONS. Goiffon, A.; Granger, R.; Bockel, C.; Spinner, B. (Univ., Algiers). Rev. Chim. Miner.; 10: No. 3, 487-502(1973). (In French).

The systematic study of solutions having pH values varying between 8.5 and 15 enabled the regions in which niobium(V) ions exist to be separated: the isopolyanions, $H_xNb_6O_{19}^{8-x}$ with x = 0, 1, 2, and 3 are simultaneously present for pH values <13.97. The stability constants of these isopolyanions were verified. When 13.97 < pH < 14.47, an equilibrium exists between $Nb_6O_{19}^{8-}$ and $Nb_6O_{12}(OH)_7^{5-}$ (formation pK = 0.61); a transformation into $Nb_4O_{12}^{8-}$ (pK = 11.96) and $NbO_2(OH)_2^{-}$ (pK = 3.23) takes place in more alkaline media. The relative proportions of these last species depends upon the niobium concentration. The absorption spectra of all these species were obtained between 220 and 300 nm. (FR)

29032 MICROIODOMETRIC METHOD FOR THE DETERMINATION OF ERBIUM. Shakhtakhtinskaya, N. G. Iskenderov, M. G. Azerb. Khim. Zh.; No. 1, 105-107(1973). (In Russian).

It is established that precipitates obtained by interaction of Er ions with arsenate ions have the formula $ErAsO_4 \cdot 2H_2O$. The solubility is determined and the solubility product is calculated as 3.5×10^{-6} g.mol/l at 20°C. The precipitation of the arsenate is proposed as a micrometric method for the determination of Er; 0.027 mg of Er can be determined in 5 ml of solvent with this method. (tr-auth)

29033 MEASUREMENT FOR ISOTOPIC ABUNDANCES. Honda, M. (Tokyo Univ.). Kagaku No Ryoiki; 27: No. 5, 375-383(May 1973). (In Japanese).

Review was made on the determination of isotopic abundance ratio by the mass spectroscopic method, relation between the abundance ratio and atomic weight, problems in the relative measurement of the ratio, standard materials for the determination of the abundance ratio and extraterrestrial materials, and specific topics on various elements. Use of mass spectrographs is classified into 2 groups depending on the method of the use, namely, measurement with high sensitivity, by which an atomic number of 10^8 to 10^{10} is measured, and measurement with high precision, in which the degree of precision is ±0.01%. ^{3}He is the most stable isotope on earth. The ^{3}He/^{4}He ratio is 10^{-6} to 10^{-7}. The ratio varies to a large extent depending on nuclear phenomena, solar wind, cosmic irradiation, and α disintegration. The determination of isotopic abundance is difficult for ^{42}Ca, ^{46}Ca, and ^{48}Ca. ^{22}Ti also shows large scattering of measured values in the range of 7.3-7.8%. The abundance ratio of ^{30}Zn is not precisely determined, because this element is not suited for determination by the surface ionization method. For ^{73}Ta, the presence of ^{180}Ta was detected quite recently, in 1956-58. The presence of isotopes such as ^{239}Pu, ^{237}Np, ^{244}Pu, ^{247}Cm was confirmed in natural minerals recently. (JA)

29034 STANDARD METHODS FOR CHEMICAL, MASS SPECTROMETRIC, AND SPECTROCHEMICAL ANALYSIS OF NUCLEAR-GRADE URANIUM DIOXIDE POWDERS AND PELLETS. Philadelphia; American Society for Testing and Materials (1972). 39p. (ASTM-C-696-72).

Procedures for the chemical, mass spectrometric, and spectrochemical analysis of nuclear-grade uranium dioxide powders and pellets are given. Selection of a method for determining uranium depends on the amount of sample, the purity of the material, the precision required, and the equipment available. (LK)

29035 STANDARD METHODS FOR CHEMICAL, MASS SPECTROMETRIC, AND SPECTROCHEMICAL ANALYSIS OF NUCLEAR-GRADE PLUTONIUM DIOXIDE POWDERS AND PELLETS. Philadelphia; American Society for Testing and Materials (1972). 37p. (ASTM-C-697-72).

Standard procedures are given for determination of plutonium by controlled potential coulometry, by ceric sulfate titration method, by amperometric titration with iron(II), and by mass spectroscopy. Methods are also given for determination of nitrogen, carbon, chloride, fluoride, sulfur, rare earths, trace elements, and impurity elements in plutonium dioxide powders and pellets. (LK)

29036 HETEROCYCLIC AZO-DYES DERIVED FROM 1-NAPHTHOL-4-SULFONIC ACID AS METALLOCHROMIC INDICATORS. Sommer, L.; Koblizkova-Danesova, V. (Purkyne Univ., Brno). Collect. Czech. Chem. Commun.; 39: No. 2, 396-415(Feb 1974).

Analytical reactions and acid-base equilibria of three N-hetero-

cyclic azo-dyes, derived from 1-naphthol-4-sulfonic acid, were studied in various media. The dyes proved to be good indicators of the equivalence point for EDTA titrations and for the photometric microtitration of copper with EDTA. The course of model titrations as well as the accuracy and correctness of the evaluation of the end point were followed visually, spectrophotometrically, and potentiometrically. (auth)

29037 MICRODETERMINATION OF PLATINUM METALS BY THE RING OVEN TECHNIQUE USING POTASSIUM THIOCARBONATE. Kaushik, N. K.; Johri, K. N. (Univ. of Delhi). Mikrochim. Acta; No. 2, 267-274(1974).

An efficient and speedy method for the estimation of ruthenium(III), rhodium(III), palladium(II), osmium(VIII), iridium(III) and platinum(IV) is described by using ring colorimetry with potassium thiocarbonate (PTC). Binary mixtures show the following limits when present in 1.5 μl of solution, Ru(III) 0.49 μg; Rh(III) 0.43 μg; Pd(II) 0.38 μg; Os(VIII) 0.71 μg; Ir(III) 0.53 μg; Pt(IV) 0.38 μg; present singly the limits are 0.20 to 0.30 μg. (auth)

29038 DETECTION OF IODINE, BROMINE, ARSENIC(III), TIN(II), MERCURY(II), SILVER, THIOSULFATE, AND SULFITE USING SETOGLAUCINE O AND SETOCYANINE SUPRA. Eswara Dutt, V. V. S.; Venkateswara Rao, N. (Andhra Univ., Waltair, India). Mikrochim. Acta; No. 2, 295-300(1974).

Setoglaucine O and Setocyanine Supra can be employed for the detection of iodine, bromine, arsenic(III), tin(II), mercury(II), silver(I), thiosulfate and sulfite. The method for iodine or bromine consists of treating 0.05 ml of 0.01% solution of Setoglaucine O or Setocyanine Supra on the spot plate, with 0.05 ml of iodine or bromine solution, and diluting the mixture to 0.5 ml. Color changes are blue to yellow green for iodine and blue to pale yellow for bromine. The tests for arsenic(III), tin(II), mercury(II), silver(I), thiosulfate and sulfite consist of treating 0.1 ml of 0.01% Setoglaucine O or Setocyanine Supra with 0.05 ml of iodine in potassium iodide and 0.05 ml of the test solution, and diluting to 1 ml. The solution assumes the original blue color of the dye in the presence of these ions. (auth)

29039 APPLICATION OF OXINE IN THE POLAROGRAPHIC ANALYSIS OF ORGANOMETALLIC COMPOUNDS. II. Microdetermination of Cu, Pb, Al, Fe, U, and Ni. Bishara, S. W.; Sakla, A. B.; Attia, M. E.; Hassan, H. N. A. (National Research Centre, Cairo). Mikrochim. Acta; No. 2, 257-266(1974).

A micromethod for the determination of copper, lead, aluminium, iron, uranium, and nickel in organic compounds is presented. Mineralization of sample is accomplished using either the closed flask combustion method (for Cu-, Pb-, Al-, Fe-, or U-containing organic compounds) or the open flask digestion procedure (for Pb-, Al-, Fe-, or Ni-containing compounds). The decomposition process differs from one metal to the other, but the method of determination to follow is the same for all metals investigated. The excess of 8-hydroxyquinoline reagent, added to precipitate the metal-oxine complex, is measured polarographically. Average % errors of ±0.54 and ±0.65 are obtained using the oxygen-flask method and the wet decomposition technique, respectively. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 29168, 29462, 29522, 29559, 29854, and 31550.

29040 (BNWL-1850(Pt. 2), pp 125-129) RADIOANALYTICAL PROCEDURES DEVELOPMENT. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Developments in the past few years have radically changed the requirements of radiochemical separations in radionuclide analyses. Advances in gamma spectrometry, particularly those using multidimensional and solid state Ge(Li) detectors as well as x-ray fluorescence spectrometry have provided selective and sensitive instruments for analysis and have substantially modified the requirements of radiochemical procedures. There is at present an urgent need for procedures that quantitatively separate a radionuclide mixture obtained from natural systems or from one created in the course of elemental analyses such as with neutron activation. The developing techniques are those that divide the mixture into two or three groups or that quantitatively remove an interfering constituent so that the resulting group(s) can be quantitatively measured by instrumental techniques. Procedures have also been developed to measure specific elements such as Hg found to coexist with certain trace radioactive or stable constituents of environmental samples. (auth)

29041 (CONF-740510-1) COMBINED SOLVENT EXTRACTION-LIQUID SCINTILLATION METHODS FOR RADIOASSAY OF ALPHA EMITTERS. McDowell, W. J.; Coleman, C. F. (Oak Ridge National Lab., Tenn. (USA)). 1974. 16p. Dep. NTIS $4.00.

From international solvent extraction conference; Lyon, France (May 1974).

Alpha emitting nuclides frequently can be separated from one another and from interfering ions by solvent extraction procedures. If the last step of such a scheme automatically incorporates the nuclide of interest in a liquid scintillator (containing an extractant), a simple procedure for radioassay of the nuclide results. It is shown that correct choices of scintillators and detector systems produce further advantages. Quenching is minimized and held constant, so that the pulse height obtained from a given alpha energy is reproducible, and the energy resolution is improved over that obtainable with conventional liquid scintillation methods, so that alpha peak widths are decreased from around 1 MeV to 0.2 to 0.3 MeV at half maximum. Compatibility of several extractants with scintillator solutions is described. Procedures are described for separation and analysis of several nuclides (e.g., plutonium, uranium, and trivalent actinides), including a specific application to the assay of plutonium in environmental samples. (auth)

29042 (FDA-73-8029, pp 207-213) ASSAYS OF RADIOACTIVE MATERIALS FOR PATIENT USE: RESULTS OF A TEN YEAR STUDY. Vacca, P. C.; Semler, M. O.; Brown, J. M. Jr. (Dept. of Health, Education, and Welfare, Bethesda, MD). Mar 1973.

In health physics in the healing arts.

Since 1953, the Radiation Safety Section of the National Institutes of Health (NIH) has been responsible for the assay and radionuclidic purity verification of all radioactive materials used in patients in the Clinical Center. During this period more than 30,000 assays have been performed on 40 different radionuclides. The NIH assay methods are described and results for the 10-year period, January 1, 1962 through December 31, 1971, are reviewed. (auth)

29043 (INIS-mf-974) RADIOCHEMICAL PROBLEMS RELATED TO POST-IRRADIATION ANALYSIS OF FUEL ELEMENTS. Cesarano, C.; Marangio, G.; Naticchioni, A. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). Oct 1972. 21p. INIS.

From second Italian-Polish meeting on some chemical, ceramic, and metallurgic aspects of nuclear fuels; Rome, Italy (3 Oct 1972).

Radiochemical analyses play an important role in post irradiation evaluation of fuel elements, because they allow through various methods a rather accurate measurement of the burnup. A more detailed measurement of the distribution of fission products, either volatile or stable, is possible both along the radius and the axis of the fuel, by means of radiochemical techniques. However the great progress of the equipment used for radiations detection or for mass has somehow restricted the need for radiochemical separation and broadened instrumental techniques. This report describes the activities of the Casaccia Hot Laboratory (OPEC-2). The need of the radiochemical work has been evaluated in view of the most modern trend in analytical techniques and a number of alpha tight boxes properly equipped will be constructed. Two analytical procedures are anticipated: the first one will be related to the daily irradiation requirements; the second one will be directed toward more special analyses in order to achieve a more detailed knowledge of the behavior of fuel elements under irradiation. (INIS)

29044 RADIOKHIMICHESKII ANALIZ OB'EKTOV VNESHNEI SREDY. Doklady na III Radiokhimicheskom Soveshanii v g. Obninske 21–24 Iyunya 1970 g. i na IV Radiokhimicheskom Soveshanii v g. Leningrade 25–28 Mai 1971 g. (Radiochemical Analysis of Objects of the External Medium. Proceedings of the III Radiochemical Conference, Obninsk, USSR, June 21–24, 1970 and IV Radiochemical Conference, Leningrad, USSR, May 25–28, 1971). Bobovnikovoi, Ts. I. (ed.). Moscow; Moskovskoe Otdelenie Gidrometeoizdata (1972). 143p. (CONF-700682-; CONF-710569-).

Radiochemical methods for the determination of fission products and isotopes in objects of the environment and in biomaterials are reported. Questions of metrology as applied to radiochemical analysis and some questions on spectrometric analyses are examined. Methods for the analysis of U, ^{239}Pu, Am, Cm, Cf, ^{131}I, Po, T, ^{7}Be, ^{46}Sc, Mn radioisotopes, ^{59}Fe, ^{57}Co, ^{60}Co, radioactive Cu isotopes, ^{65}Zn, ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{99}Mo, Ru isotopes, Cd isotopes, ^{113}Sn, ^{132}Te, ^{95}Zr, ^{125}Sb, radioactive isotopes of Rb and Cs, radioisotopes of Eu, ^{182}Ta, ^{97}Zr, radioisotopes of W, ^{203}Pb, ^{210}Pb, Np, and iodine isotopes are given. (JSR)

29045 RADIOMETRIC TITRATION OF MOLYBDENUM(V) WITH COMPLEXON III. Martynov, A. M.; Staroverova, L. L.; Shamaev, V. I. (Moscow Chemical-Technological Inst.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 11, 1644-1646(1973). (In Russian).

The Mo sample is brought into solution; 99 Mo tracer activity is added and Mo(VI) is reduced to Mo(V) with hydrazine hydrochloride. The solution is then divided into a number of aliquot parts. Varying amounts of EDTA are added to each aliquot, and uncomplexed Mo(V) is precipitated as the sulfide from 0.1 to 0.5 N HCl. The equivalence point is found by measuring the activity of the aqueous filtrate containing the Mo(V) EDTA complex. The error was 1 to 2% at a Mo concentration of 0.0004 to 0.01 mols/liter. The error rises to 11% at a Mo concentration of 0.00004 mols/liter. The selectivity of the method is high, since EDTA complexes Mo in acid solution where other metals such as Al, Co, Ni, Cd, Cu, and Zn do not react with EDTA. The method was used for the determination of Mo in tungsten preparations. The error is only 1 to 2% at W/Mo ratios up to 10, and increases to 8% at a W/Mo ratio of 15. (SJR)

29046 CERIUM–MISCHMETALL (CeMM) AND CeMM–COBALT ANALYSIS BY X-RAY FLUORESCENCE. Feldmann, D.; Grill, A.; Mark, W. (Bochum Univ., Ger.). Z. Metallk.; 64: No. 12, 848-852(Dec 1973).

In the development of permanent magnets on the basis of CeMM–$Co_{(5:1)}$ it proved to be necessary to have an accurate knowledge of the chemical composition of the CeMM. A sample preparation and an x-ray fluorescence method have been developed which permit a quick analysis of the samples with sufficient accuracy. (GE)

29047 RADIOISOTOPE ON-STREAM ANALYSIS. Development History of an Award-Winning System. Watt, J. S. At. Energy Aust.; 16: No. 4, 3-19(Oct 1973).

The historical development of radioisotope on-stream analysis using x-ray fluorescence is reviewed. Developments included the design and construction of x-ray sources, x-ray detectors, and immersion probes. Applications to ore processing in industrial plants are described. (auth)

29048 ON-STREAM ANALYSIS OF HEMATITE ORE FRACTIONS USING RADIOISOTOPES. Reed, D. J.; Dalton, J. L.; Gillieson, A. H. (Dept. of Energy, Mines, and Resources, Ottawa). X-Ray Spectrom.; 3: No. 1, 15-20(Jan 1974).

Hematite ore fractions in the form of circulating slurries of various solids content were analyzed for iron and silicon, their principal metallic constituents, to determine the relationships and factors significant to such analyses. Radioisotopes were used to excite the characteristic radiations which were measured nondispersively. Counts were also taken for the exciting radiations. The measured intensities for Fe Kα and Si Kα were corrected by backscatter and absorption factors derived by the comparison of counts from the slurries to those from water. Regression lines were used to convert all counts to a 40% solids basis. The iron content of the ore fractions was determined with a standard error of less than 2%. The determination of silicon was not satisfactory at low concentrations because all components of the slurries absorb Si Kα strongly. (auth)

29049 NONDESTRUCTIVE RADIOISOTOPE XRF ANALYSIS OF EARLY ETRUSCAN GOLD OBJECTS. Cesareo, R. (Univ., Rome); von Hase, F. W. Kerntechnik; 15: No. 12, 565-569(Dec 1973). (In German).

Measurements carried out on several early Etruscan gold objects of the 7th century B. C., with aid of a portable measuring device working on the principle of x-ray fluorescence excited by a radionuclide source are described. This device makes it possible to carry out non-destructive determinations of the gold, silver, and copper contents of gold alloys, within a measuring time of 10 s per element. (auth)

29050 TERNARY SYSTEMS OF DIFFERENTIAL FILTERS FOR SIMULTANEOUS X-RAY RADIOMETRIC DETERMINATION OF TWO ELEMENTS. Nikitin, V. N.; Obolentsev, L. A.; Krol, E. Ya. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 96-101 of Yaderno-Fizicheskie Metody Issledovaniya pri Razvedke i Ekhspluatatsii Mestorozhdeni Tsvetnykh, Redkikh i Ftorosoderzhashchikh Poleznykh Iskopaemykh. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

A method was proposed for the calculation of the differential filters for the quantitative x-ray radiometric element determination based on the maximum separation of the analytical emission of the elements to be determined according to intensity transmitted (for one filter) and the equal absorption of the radiation found at different distances from the transmission band (for a pair of filters). The surface density of a system of two and three filters was calculated from the balancing conditions according to tabulated values of the mass absorption coefficient for different energies of the characteristic x radiation. A calculation was made of filters for the simultaneous determination of a combination of two elements distributed in raw materials. Thus for the determination of the Cu–Zn pair, Co–Ni–Cu filters were used with a calculated surface density of 7.6, 7.0, and 6.6 mg/cm^2: for Pd–Ag–Mo–Ru–Rh (43.3, 36.7, and 34.5 mg/cm^2). The good balancing of the filters, given by the calculation data, was confirmed experimentally. (tr-auth)

29051 ISOTOPE DILUTION MASS-SPECTROMETRY OF CALCIUM. IV. Determination of Chemical Components at the ppb Level in Both Polar Snow Strata. Murozumi, M.; Nakamura, S. (Muroran Inst. of Tech., Hokkaido, Japan). Jap. Anal.; 22: No. 12, 1548-1553(Dec 1973). (In Japanese).

Isotope dilution mass-spectrometry can be applied to the determination of minute amounts of calcium in distilled water, deionized water and snow melts from ice sheets in Greenland and Antarctica. The amount of sample required is 20 g for snow analysis. In a 100-ml teflon beaker, 0.3×10^{-7} M of ^{42}Ca spike in 0.06 g of dilute nitric acid is accurately weighed. Snow melt is poured directly into the beaker from the agitated sample bottle and is weighed. The mixture is evaporated to 50 μl in a heated steel tank in which high purity nitrogen gas is streaming. Small drops of the concentrated liquid are loaded onto the tantalum filament by using a quartz micropipette. The ion source used is equipped with a specially designed single filament unit which is heated with accurately controlled electric current. This emits intensive Ca^+ beams from 10^{-10} g of calcium salts loaded on the filament. The coefficient of variation for the peak height ratio of ^{42}Ca to ^{40}Ca ranges between 0.22 and 0.66% and is not affected by the coexistence of foreign substances. The degree of isotope effects is reduced to a minimum under 1% by running the mass-spectrometer under common conditions. Calcium and potassium have the isobars with the mass number of 40, but the isobar effects can be reduced to a negligible quantity by baking treatments. Snow melts contain minute amounts of silicate mineral dusts which have played important roles as the nucleation center for water vapor at the formation of snow flakes. So it is important that calcium added as a spike is equilibrated isotopically with that in the silicate mineral dusts. If it is not so, calcium isotopes in a salt matrix may be more easily released from the heated filament than those combined with the silicate matrix, and this will result in lower value of calcium. From the content of titanium, calcium from the silicate mineral dusts accounts for nearly 10% of total calcium in snow melts, while the remaining calcium occurs in sea salts predominantly. The concentrations of calcium are found to be 1.9 ppb in both redistilled and deionized water, 2 ppb in snow melts of West Enderby Land, Antarctica, and several ppb in those of Camp Century, Greenland. In Greenland snow strata, calcium concentrates in winter layers as well as dusty components. In both the polar regions, no appreciable variations of calcium concentration have been detected in whole year composite samples since 1750. (auth)

29052 X-RAY RADIOMETRIC INSTRUMENTATION IN THE ANALYSIS OF ORES DURING PROSPECTING AND MINING OF NON-FERROUS AND RARE METAL DEPOSITS. Leman V. P.; Bolotova, N. G.; Mitov, V. N.; Kotel'nikov, V. G. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 137-155 of Yaderno-Fizicheskie Metody Issledovaniya pri Razvedke i Ekhspluatatsii Mestorozhdeni Tsvetnykh, Redkikh i Ftorosoderzhashchikh Poleznykh Iskopaemykh. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The method, apparatus, and technology of the resources (sources, detectors, etc.) developed for use in a roentgeno-radiometric method for analyzing ores under conditions of natural strata and tests are described. Examples are presented and results of experiments that characterize the geological effectiveness and possibilities of the method and the apparatus for analyzing non-ferrous and rare metal ores in subterranean boreholes and mining operations are given. (tr-auth)

Separation Procedures

Refer also to abstracts 29077 and 31397.

29053 (INIS-mf-1224) SEPARATION OF INDIVIDUAL RARE EARTHS ELEMENTS BY ASSOCIATION OF HOMOGENEOUS PRECIPITATION AND ION EXCHANGE TECHNIQUES. Umeda, K. (Sao Paulo Univ. (Brazil). Escola Politecnica). 1973. 90p. (In Portuguese). INIS.

Thesis.

This work was developed at the Atomic Energy Institute's Chemical Engineering Department, by associating both fractional homogeneous precipitation and ion exchange techniques for the separation of Ce, Nl, Pr, Sm and La as individual rare earths from their mixed chlorides supplied by Administração da Produção

da Monazita, São Paulo. Cerium was first separated from Nd, Pr, Sm, La and other yttrium group rare earths by precipitation of Ce-IV hydroxide with urea and hydrogen peroxide as oxidant. The same technique but without hydrogen peroxide was used for the enrichment of Nd, Pr and Sm in subsequent precipitations; La was kept in the last filtrate. Experimental results showed that the precipitation is very efficient since the urea hydrolysis is easily controlled, allowing the elimination of practically all cerium and about all lanthanum, both elements being the major components of the monazite; their separation making easy later fractionation on ion exchange columns. The separation of individual Nd, Pr, Sm and La was made by two exchange (Dowex-50 W, X-8) columns, Cu^{2+} as retaining ion and EDTA-NH_4 solution buffered with acetic acid as eluent. The application of this technique has made possible the separation of individual rare earths, avoiding the precipitation inside the columns owing to acidity changes. Copper was recovered by precipitation of Cu_2S through thiourea hydrolysis in the Cu-EDTA complex solutions. The associated techniques allowed the obtention of Nd, Pr and La fractions approximately 99% pure and cerium about 95% pure. (INIS)

29054 (INP-850) PREPARATION OF HIGH PURITY MAGNESIUM OXIDE. 2. Removal of Trace Amounts of Impurities from Magnesium Nitrate Solutions. Debska-Horecka, A.; Kultk, J.; Stronski, I. (Institute of Nuclear Physics, Krakow (Poland)). Jul 1973. 21p. Dep. NTIS (U. S. Sales Only) $4.25.

The purification of magnesium salts by removing trace amounts within the range of 10^{-2} to 10^{-5}% of manganese, iron, barium, strontium+yttrium, calcium; cobalt, nickel, zinc, silver, and sodium admixtures is described. These impurities were removed from magnesium nitrate solutions by precipitating the macrocomponent in the presence of an agent complexing the microcomponents EDTA and coprecipitation with the carrier, viz. magnesium-8-hydroxy-quinolate. The purification process was controlled by means of radioactive indicators making use of the following radioactive isotopes: ^{22}Na, ^{45}Ca, ^{54}Mn, ^{59}Fe, ^{60}Ca, ^{63}Ni, ^{65}Zn, ^{90}Sr+^{90}Y, ^{133m}Ag, and ^{133}Ba. (auth)

29055 (IS-T-612) SOME PROPERTIES OF YTTRIUM AND RARE-EARTH N'-METHYLETHYLENEDIAMINE-N', N, N-TRIACETATE COMPLEXES. Johnson, D. A. (Ames Lab., Iowa (USA)). Apr 1974. Contract W-7405-eng-82. 140p. Dep. NTIS $10.00.

Thesis.

The synthesis of MEDTA is complicated by its high solubility in water. It is, however, retained on acid-form ion-exchange resin, allowing ion-exchange chromatography to be useful in isolation of this compound from the reaction mixture. The overall yield was observed to be 71%. Ion-exchange separations of the heavy rare earths with MEDTA show that the elution order is as predicted by the formation constants of the complexes. The HETP values for these separations at room temperature are somewhat smaller than those for separations with HEDTA under similar conditions. The HETP values for the two ligands at high temperature are quite similar. (LK)

29056 (ORNL-TM-4370) CHEMICAL DEVELOPMENT SECTION B SEMIANNUAL PROGRESS REPORT, MARCH 1, 1973 TO AUGUST 31, 1973. Part I. Scott, C. D.; Burtis, C. A.; Crouse, D. J.; Ferris, L. M.; Mailen, J. C.; Pitt, W. W. (comps.). (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 567p. Dep. NTIS $30.50.

Separate abstracts were prepared for the 14 sections of this report. (LK)

For abstracts of individual sections see: 29012, 29057, 29138, 29184, 29198, 29265, 29402, 29421, 30189, 31468, 31469, 31626, 31636, and 31637.

29057 (ORNL-TM-4370, pp 368-391) SEPARATIONS PROCESSES. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

Investigations in separations chemistry include work in four areas: (1) by-product recovery of uranium from wet-process phosphoric acid; (2) separation of radium from uranium ore tailings; (3) separation of alpha emitters from reprocessing wastes; and (4) study of the applicability of high-pressure ion exchange techniques to certain hydrometallurgical separations, such as nickel from cobalt, zirconium from hafnium, and niobium from tantalum. (LK)

29058 (RFP-Trans-150) THERMODYNAMICS OF THE DISTRIBUTION EQUILIBRIUM IN THE EXTRACTION OF URANYL NITRATE. Rozen, A. M. Translated from Kernenergie; 1: No. 3, 195-206(1958). 20p. Dep. NTIS $3.00.

A detailed study is made of the basic assumptions of the thermodynamics of the extraction equilibrium of uranyl nitrate. (LK)

29059 CHARACTERISTICS OF IODINE SORPTION ON ION EXCHANGE RESINS. Kotov, S. D.; Kazakov, E. V.; Suvorov, A. V. Vestn. Leningrad. Univ., Fiz., Khim.; No. 3, 102-107(Aug 1973). (In Russian).

The iodine sorption character was studied on ion exchange resins containing nitrogen and ferrocyanide–organic ionites by different methods: isotherms and isosteres of free iodine sorption or electroosmotic, electronic paramagnetic resonance, and infrared spectra. Peculiarities of sorption are due to the change of water structure. It shifts the equilibrium of molecular iodine absorption from water solution. (auth)

29060 SOLVENT EXTRACTION STUDY OF MOLYBDENUM CHLORIDE AND MOLYBDENUM THIOCYANATE COMPLEXES. Greenland, L. P.; Lillie, E. G. (Geological Survey, Washington, DC). Anal. Chim. Acta; 69: No. 2, 335-346(Apr 1974).

The effect of reducing agents on molybdenum(VI) solutions in hydrochloric acid was studied by a solvent extraction technique to elucidate the composition of the colored molybdenum thiocyanate complex. Neither copper(I) chloride nor ascorbic acid have any effect on the extraction of MoO_2Cl_2; it is inferred that tin(II) chloride reduces Mo(VI) stepwise to a polynuclear Mo(V) · Mo(VI) complex and then to Mo(V). The colored thiocyanate complex produced by copper(I) and by ascorbic acid differs only slightly in extraction characteristics from the uncolored Mo(VI) complex. It is suggested that the color may be produced by an isomerization reaction of $MoO_2(SCN)_2$ and thus that the colored species may be a hexavalent, rather than pentavalent, molybdenum complex. (auth)

29061 EFFECT OF ALCOHOLS ON THE EXTRACTION OF TITANIUM AND ZIRCONIUM FROM SULFATE SOLUTIONS BY PRIMARY AMINES. Shevchuk, I. A.; Shevtsova, L. I.; Kapkan, L. M. (Donets State Univ., USSR). Uzb. Khim. Zh.; 40: No. 1, 75-79(Jan 1974). (In Russian).

A 0.1 molar solution of primary amines C_{10}–C_{12} in chloroform was used to extract 0.01 mol/l Zr and Ti from 0.5 N sulfuric acid and varying concentrations of alcohols. The extraction of titanium decreases with increasing length of the alkyl group on the alcohol. Poor separation of phases is observed at an alcohol concentration of less than 10%. The extraction of zirconium is high even in the absence of alcohols, and depends only slightly on the type of alcohol. With the use of 20 vol % ethyl alcohol, complete extraction of titanium by the primary amines takes place, and a group extraction of zirconium and titanium can be accomplished. Nuclear magnetic resonance studies showed that the OH-group of the alcohol interacts with the anionic sulfate complex to produce an alcohol solvate which in the case of titanium is more readily extracted by primary amines. (SJR)

29062 THERMODYNAMICS OF THE EXTRACTION OF MAGNESIUM AND STRONTIUM CHLORIDES BY ISOAMYL ALCOHOL. Kazas, T. S.; Krasnov, K. S. (Ivanova Physical-Technological Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 2, 209-213(1974). (In Russian).

The extraction was investigated over a wide interval of concentrations at 25 and 50°C. The hydrate and solvation numbers of the chlorides in the organic phase were determined. At low concentrations the distribution coefficients of the salts were close to each other, and varied slightly with concentration. At high concentrations the distribution coefficients of $MgCl_2$ were higher than those of $SrCl_2$. The distribution of $MgCl_2$ falls, while that of $SrCl_2$ increases with temperature. Magnesium chloride loses 7 molecules of water on going into the organic phase, while $SrCl_2$ loses all its water. In the organic phase $MgCl_2$ is solvated with three molecules of alcohol, while $SrCl_2$ is solvated with six molecules of alcohol. On the basis of the experimental data, calculations are made on the thermodynamic characteristics of the extraction of the salts in the form of ions. On comparing the data with data on the extraction of $CaCl_2$ and $BaCl_2$ it follows that the extraction constants of Ca, Sr and Ba chlorides are equal to each other and an order of magnitude lower than the extraction constant of Mg chloride. The thermal effect of the extraction of all chlorides is $\Delta H \cong O$, and the entropy change is $\Delta S^0 \sim 50$ eV. (SJR).

29063 COMPOSITION OF MOLYBDENUM AND TUNGSTEN COMPLEXES EXTRACTED FROM FLUORIDE SOLUTIONS BY TRI-N-OCTYLAMINE (TOA). Tseryuta, Yu. S.; Bagreev, V. V.; Pal'shin, E. S. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Neorg. Khim.; 19: No. 1, 200-204(Jan 1974). (In Russian).

The mol ratios of TOA : Me : H : F in extracted compounds of Mo and W were found to be close to the ratio 1 : 1 : 2 : 4. This ratio does not change from 0.5 to 5 molar HF concentrations in the aqueous phase, and does not depend on the nature of the amine solvent. Molybdenum and tungsten are extracted by trioctylamine

(TOA) in the form of an ionic compound having the composition $TOAH \cdot HMeO_2F_4$. Extraction of micro amounts of both metals occurs in the form of the complex $(TOAH)_2MeO_2F_4$. (SJR)

29064 TRENDS IN THE DISTRIBUTION OF INDIVIDUAL RARE EARTH ELEMENTS DURING EXTRACTION WITH α,α'-DIALKYLCARBOXYLIC ACIDS AND WITH NORMAL CARBOXYLIC ACIDS. Danilov, N. A.; Korpusov, G. V.; Krylov, Yu. S.; Puzitskii, K. V.; Eidus, Ya. T. (Inst. of Physical Chemistry, Moscow). Zh. Neorg. Khim.; 19: No. 1, 194-199(Jan 1974). (In Russian).

It is shown that a monomer of the composition $LnR_3 \cdot 3HR \cdot nH_2O$ is extracted into the organic phase containing n-caproic acid or α,α'-carboxylic acids containing 9 carbon atoms in the radical connected to the carboxylic group (rare earth concentration in the organic phase was 3.2×10^{-3} to 10^{-5} mol/l). The apparent constants for the extraction of rare earths by α,α'-carboxylic acids (C_9) were in K 10^{-14} units: 1.26 for La; 2.45 for Ce; 6.92 for Pr; 14.1 for Nd; 67.6 for Sm; 52.5 for Eu; 11 for Gd; 15.5 for Dy; 21.9 for Ho; 5.49 for Tm; 6.92 for Yb, and 7.41 for Lu. It is shown that the mols of water in the extracted complex are not constant, but vary from 1 to 2 as a function of the concentration of rare earth carboxylate in the organic phase. (SJR)

29065 EXTRACTING ALKALI METAL COMPOUNDS WITH SOLUTIONS OF A POLYMERIZED ALKYLPHENOL IN C_7-C_9 ALCOHOLS. Bukin, V. I.; Plyushchev, V. E.; Reznik, A. M.; Smirnova, A. G. (Moscow Inst. of Fine Chemical Technology, Chemistry, and Technology of Rare and Dispersed Elements). Zh. Neorg. Khim.; 19: No. 1, 174-177(Jan 1974). (In Russian).

Polymerized para-octylphenol, SP, is an efficient extractant of alkali metals. However, separation of a solid phase is observed on extracting with a solution of SP in kerosene. Samples of the polymer SP-1047 consisted mainly of the tetramer (99.8%). Analysis for the alkali metals was carried out by flame photometry. No separation of solid phase occurs when an alcohol is used as a diluent. The distribution coefficient increases with increasing dielectric constant of the alcohol diluent. A technical mixture of C_7-C_9 alcohols was found to be the most effective diluent for extracting alkali metal with a 0.1 mol solution of SP. Cesium extracts better than rubidium and potassium at concentrations of <0.035 mol/liter. At high concentrations of organic extractant SP the viscosity of the organic phase increases, and phase separation is slow. The solvation number is 2, that is, two molecules of cesium react with one molecule of organic extractant. A sulfate solution of the following composition was subjected to extraction with equal volumes of organic and aqueous: Rb-0.36 g/l; Cs-0.026; Li-0.34; K-15.7; Ca-0.2 and Na-0.32 g/l. The alkali metals were back-extracted from the organic phase into 1.0 N HCl. The extractions of Cs, Rb, and Li were 100, 30 and 30% respectively. Separation coefficients were 31.6 for Cs/Rb, 52.4 for Cs/K and 1.7 for Rb/K. Cesium is partially separated from the other alkali elements. (SJR)

29066 MECHANISM AND CONDITIONS OF BACK-EXTRACTION OF SCANDIUM FROM DI-2-ETHYLHEXYLPHOSPHORIC ACID. Favorskaya, L. V.; Koshul'ko, L. P.; Granovskii, Yu. V.; Komissarova, L. N.; Krivenko, S. V.; Bazhapova, A. P. (Moscow State Univ.). Zh. Neorg. Khim.; 19: No. 1, 168-173(Jan 1974). (In Russian).

Studies were carried out on a 0.4 N di-2-ethylhexylphosphoric acid (HDEHP) solution in kerosene containing 4 g/l scandium oxide. The organic phase was contacted with solid sodium fluoride during continuous agitation over a period of 1 hr. The precipitate was separated from the organic phase by filtration, and analyzed for its scandium content after washing with kerosene to remove traces of HDEHP. At a 6:1 mol ratio of fluoride to scandium ions only 23% of the scandium was back-extracted from the HDEHP solution; this value increased to 31% back-extraction of scandium at a 12:1 mol ratio of F to Sc, and rose to 98% Sc back-extraction at a 36:1 mol ratio of F to Sc. X-ray analysis of the precipitates showed that ScF_3 forms at a 6:1 ratio of F to Sc; some $NaScF_4$ forms at a 12:1 ratio of F to Sc, while the sodium hexafluoride Na_3ScF_6 is formed at a 36:1 mol ratio of F to Sc. Thus a large excess of sodium fluoride with formation of Na_3ScF_6 is necessary for complete back-extraction of scandium to form a 0.4 N HDEHP in kerosene. (SJR)

29067 DESULFURIZATION OF FLUE GASES. Fleming, J. W. (to Koppers Co., Inc.). US Patent 3,795,732. 5 Mar 1974. Filed Date 17 Dec 1971. 8p.

A process and apparatus for removing sulfur oxides from combustion gases and the like in which the gases are contacted with vanadium pentoxide to convert any sulfur dioxides present therein to sulfur trioxide and absorbing the sulfur trioxide with lithium sulfate which is converted to lithium pyrosulfate. The lithium pyrosulfate can be converted back to lithium sulfate for reuse in the system and sulfur trioxide liberated thereby used in the production of sulfuric acid. (Official Gazette)

29068 ATMOSPHERE PURIFICATION OF RADON AND RADON DAUGHTER ELEMENTS. Stein, L. (to United States Atomic Energy Commission). US Patent 3,778,499. 11 Dec 1973. Filed date 13 Apr 1971. 6p.

A method for purifying an atmosphere of radon and radon daughter elements which may be contained therein by contacting the atmosphere with a fluorinating solution, whereby the radon and radon daughters are oxidized to their respective fluorides is discussed. The fluorides dissolve in the fluorinating solution and are removed from the atmosphere, which may then be recirculated. (Official Gazette)

29069 ATMOSPHERE PURIFICATION OF RADON AND RADON DAUGHTER ELEMENTS. Stein, L. (to United States Atomic Energy Commission). US Patent 3,784,674. 8 Jan 1974. Filed date 9 Sep 1971. 6p.

A method of removing radon and radon daughter elements from an atmosphere containing these elements by passing the atmosphere through a bed of fluorinating compound whereby the radon and radon daughters are oxidized to their respective fluorides is discussed. These fluorides adhere to the fluorinating compound and are thus removed from the atmosphere which may then be recirculated. A method for recovering radon and separating radon from its daughter elements is also described. (Official Gazette)

29070 EFFECT OF TETRABUTYLAMMONIUM ION ON THE EQUILIBRIUM OF Nd^{3+} AND Pr^{3+} IONS WITH AN EDTA SOLUTION IN THE PRESENCE OF A CATION EXCHANGER. Martynenko, L. I.; Yashkarova, M. G. (Moscow State Univ.). Zh. Neorg. Khim.; 18: No. 11, 3040-3042(Nov 1973). (In Russian).

A study was made of the effect of the large tetrabutylammonium ion $N(C_4H_9)_4^+$ on the rate of establishment of equilibrium in the system of a cation exchanger-rare earth ion (Pr^{3+} or Nd^{3+})-EDTA solution. The data indicate that tetrabutylammonium ions in chloride solution displace Nd^{3+} ions from a cation exchanger NdR_3 more slowly than K^+ or NH_4^+ ions do in an NH_4Cl or KCl solution of the same concentration. Constant pH of the final solution is attained more slowly with tetrabutylammonium ions than with K^+ or NH_4^+ ions of the same concentration. It was found that displacement from the solid cation exchanger was the limiting reaction rather than EDTA complexing. (SJR)

29071 EXCHANGE OF Er^{3+} AND Ho^{3+} IONS BETWEEN A CATION EXCHANGER AND A SOLUTION OF ETHYLENE DIAMINETETRACETATE (EDTA). Yashkarova, M. G.; Martynenko, L. I. (Moscow State Univ). Zh. Neorg. Khim.; 18: No. 11, 3136-3137(Nov 1973). (In Russian).

It was found that interrupting contact between the rare earth cation exchanger and the EDTA solution had no effect on the degree of equilibrium that was attained. The effect of grain size of the cation exchanger also had no effect on the rate of ion-exchange. Hence the rate-determining step of this exchange reaction is a step associated with an exchange in solution (chemical kinetics). The Er/Ho pair form weak complexes with EDTA, and this EDTA complexing step becomes limiting. On the other hand, the Nd/Pr pair form strong complexes with EDTA in solution, and the rate-limiting step becomes diffusion through the film surrounding the cation-exchanger particle. (SJR)

29072 SEPARATION OF THE TRIVALENT ACTINIDES FROM THE LANTHANIDES BY EXTRACTION CHROMATOGRAPHY. Filer, T. D. (Atomic Energy Commission, Idaho Falls, ID). Anal. Chem.; 46: No. 4, 608-610(Apr 1974).

The following conditions were selected for optimum separation of the trivalent lanthanides from the trivalent actinides at room temperature: 10- by 100-mm column of 70- to 80-mesh Tee-Six powder containing 0.45 M HDEHP-heptane as the stationary phase, 0.025 M DTPA in 1 M monochloroacetic acid adjusted to a pH of 3.0 with NH_4OH as eluant, and a flow rate of 10 to 12 drops per minute. (LK)

29073 DETERMINATION OF URANIUM IN BIOLOGICAL MATERIALS. Csovari, M.; Molnar, L. Magy. Kem. Foly.; 80: No. 1, 16-19(Jan 1974). (In Hungarian).

A new method of uranium determination is reported. The method is based on the extraction of uranium with dibutyl phosphate. The antagonistic effect of long-chain alcohols on the extraction has afforded a possibility for the reextraction of uranium simply with solutions of mineral acids. The efficiency of the method is 0.96 ± 0.018. (auth)

29074 THERMODYNAMIC STUDIES ON THE SOLVENT EXTRACTION OF EUROPIUM NITRATE INTO VERSATIC ACID 911-

BENZENE SOLUTION. Shigematsu, T. (Kyoto Univ.); Tanabe, T.; Kondo, Y.; Nishimura, S. Trans. Jap. Inst. Metals; 14: No. 6, 496-503(Nov 1973).

The extraction equilibrium of $Eu(NO_3)_3$ from aqueous solution into Versatic acid 911-benzene solution was studied. The vapor pressure of benzene in this binary organic solution was measured by the transpiration method at 15, 25 and 35°C. And the activity coefficient of Versatic acid 911 in this solution was calculated by the Gibbs–Duhem equation. On the other hand, the distribution equilibrium of Eu^{3+} ion between aqueous and organic solutions was measured at the above-mentioned temperatures by using a mixture of ^{152}Eu and ^{154}Eu as the radioactive tracer. The composition of extracted species and the equilibrium constant of extraction were determined by taking the calculated values of activity of Versatic acid 911 into consideration. Furthermore, enthalpy and entropy changes of the extraction were calculated in the following way: Extracted species: $EuR_3 \cdot 4RH$; $\Delta H^0 = 15.4$ (kcal/mol); $\Delta S^0 = 37.8$ (e.u.). (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 29184, 30034, 31224, 31228, and 31468.

29075 (COO-2217-5) INVESTIGATION OF MOLECULAR MECHANISMS IN PHOTODYNAMIC ACTION AND RADIOBIOLOGY WITH NANOSECOND FLASH PHOTOLYSIS AND PULSE RADIOLYSIS. Progress Report, July 1, 1973–June 30, 1974. Grossweiner, L. I. (Illinois Inst. of Tech., Chicago (USA)). 1974. Contract AT(11-1)-2217. 24p. Dep. NTIS $4.25.

The mechanism of photodynamic oxidation of aqueous iodide ion sensitized by eosin was investigated with laser flash photolysis and analog computer analysis. It was demonstrated that $^1\Delta_g$ singlet oxygen is the principal oxidizing agent leading to the I_2^- intermediate. Evidence for the equilibrium $I_2^- + I^- \rightleftharpoons I_3^-$ was obtained with $K \approx 1 \times 10^3\ M^{-1}$. New work on photodynamic action in membranes was initiated where the spin label ESR technique was employed to probe the local damage. Preliminary results on liquid stearic acid indicate that irradiation with visible light in the presence of eosin alters the local order of the crystalline and liquid phases and that oxygen contributes to the effects. Pulse radiolysis and cobalt-60 studies on splitting of thymine dimer by ionizing radiation have led to a reductive pathway initiated by hydrated electrons and an oxidative pathway from the attack of hydroxyl radicals. The results suggest reasonable mechanisms for photosensitized cleavage of pyrimidine dimers as sensitized by various dyes and aromatic amino acids. (auth)

29076 (GKSS-74-E-4) CONCENTRATION DEPENDENCE OF THE MOLECULAR CROSS SECTION OF THE SOLUTIONS OF METHANOL AND WATER IN HEAVY WATER. Suszkin, A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1974. 9p. Dep. NTIS (U.S. Sales Only) $4.00.

The concentration dependence of the molecular cross section of two hydrogen-binding liquids in heavy water solution was calculated and compared with measured values. The average hydrogen cross section of one solution was changing with the concentration, whereas no change in the molecular bonding was observed. (auth)

29077 (IS-T-621) RARE EARTH ION ACTIVITIES BY STATIC VAPOR AND SPECIFIC ION ELECTRODE MEASUREMENTS WITH APPLICATION TO A SINGLE COMPONENT SOLVENT EXTRACTION SYSTEM. O'Brien, W. G. (Ames Lab., Iowa (USA)). Apr 1974. Contract W-7405-eng-82. 193p. Dep. NTIS $12.75.

Thesis.

A static vapor pressure measuring device was developed with a precision of 0.00005 mm Hg. The vapor pressures of Nd and La nitrate solutions were measured. A nitrate ion electrode was used to measure the nitrate ion activities in pure neodymium nitrate and lanthanum nitrate solutions. The activity and activity coefficient of the free Nd(III) ion was determined. The vapor pressures of binary electrolytic solutions consisting of neodymium nitrate and nitric acid were measured. The pH electrode was used to measure the hydrogen ion activity of this solution, and the nitrate ion electrode was used to measure the nitrate ion activity. The extraction of Nd from an aqueous phase to an organic phase by di-2-(ethyl hexyl)-phosphoric acid (HDEHP) was also studied. The distribution coefficient of the Nd and the solvent extraction equilibrium constants were found. (JSR)

29078 (MLM-2110) EFFECT OF ISOTOPIC EXCHANGE AND DILUTION ON HTO PERMEATION. Abell, G. C. (Mound Lab., Miamisburg, Ohio (USA)). 6 Mar 1974. Contract AT-33-1-GEN-53. 9p. Dep. NTIS $4.00.

The effect of isotopic exchange on the diffusion of tritiated water (HTO) through materials that contain readily exchangeable protons is described in detail. Under certain conditions isotopic exchange is shown to result in a dramatic reduction in the rate of HTO penetration through these materials. The significance of this finding is its potential application to personnel protection from tritium. (auth)

29079 HIGH-RESOLUTION INFRARED SPECTRA OF THE $10^0 1$ BAND OF $^{12}C^{32}S^{34}S$ AND $^{13}C^{32}S^{34}S$. Blanquet, G.; Walrand, J.; Courtoy, C. P. (Univ., Notre Dame, Namur, Belgium). Ann. Soc. Sci. Brux. Ser. I; 88: No. 1, 87-100(1974). (In French).

The $10^0 1$ bands of the isotopic forms $^{12}C^{32}S^{34}S$ and $^{13}C^{32}S^{34}S$ were analyzed. The band centers are at 2172.771 and 2122.184 cm^{-1} respectively. The ground level constants are $B_0 = 0.105919$ and $D_0 = 0.98 \times 10^{-8}$ cm^{-1} for $^{12}C^{32}S^{34}S$ and $B_0 = 0.105916$ and $D_0 = 0.96 \times 10^{-8}$ cm^{-1} for $^{13}C^{32}S^{34}S$. It is the first band of $^{12}C^{32}S^{34}S$ and the second band of $^{12}C^{32}S^{34}S$ obtained in high-resolution infrared spectroscopy. (tr-auth)

29080 PRODUCTION OF SINTERED POROUS METAL FLUORIDE PELLETS. Anderson, L. W.; Stephenson, M. J. (to United States Atomic Energy Commission). US Patent 3,781,392. 25 Dec 1973. Filed date 7 Oct 1971. 6p.

Porous pellets characterized by a moderately reactive crust and a softer core of higher reactivity are produced by forming agglomerates containing a metal fluoride powder and a selected amount of water. The metal fluoride is selected to be sinterable and essentially non-reactive with gaseous fluorinating agents. The agglomerates are contacted with a gaseous fluorinating agent under controlled conditions whereby the heat generated by localized reaction of the agent and water is limited to values effecting bonding by localized sintering. Porous pellets composed of cryolite (Na_3AlF_6) can be used to selectively remove trace quantities of niobium pentafluoride from a feed gas consisting predominantly of uranium hexafluoride. (Official Gazette)

29081 EFFECT OF FORMATION CONDITIONS ON THE COMPOSITION OF ANODIC TANTALUM OXIDE. Bogoyavlenskii, A. F.; Zakhvatov, G. I. (Kazan Aviation Inst.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 11, 1653-1655 (1973). (In Russian).

The absolute and relative amounts of sulfate ions occluded by an oxide film on electrochemically polished tantalum disks were determined by a tracer method as a function of electrode potential and thickness of oxide film. The occluded sulfate was determined by counting the ^{35}S-activity from $H_2{}^{35}SO_4$ on an end-window counter with a mica window thickness of 0.1 mg/cm^2. The occluded ^{35}S increases linearly with increasing electrode potential and with increasing oxide film thickness. The relative occluded sulfate $\Delta = [(g\text{-ion sulfate})/(g\text{-mol } Ta_2O_5)] \cdot 100 = 0.082\%$. Draper found a value of Δ a factor of 7 greater for sulfate occlusion on a tantalum surface immersed in molten NaOH at 400°C before anodizing. The greatest absolute content of sulfate ions (20×10^{-9} g/cm^2) was found in a very thin film (220 Å), where the effect of heterogeneity was especially large. The relative content of sulfate ions for an oxide film 220 Å thick is equal to 5%, and then gradually decreases to 0.27%. By using a high initial current density of 100 to 1000 ma/cm^2 the main part of the oxide film can be formed over a period of about 10 sec. Under these conditions the relative content of sulfate ions is a factor of 5 to 10 higher, and attains a value of 0.77% for a film 2080 Å thick. The relative and absolute content of sulfate ions increases with increasing H_2SO_4 concentration and attains a maximum at 2% H_2SO_4, then they fall gradually to 5% H_2SO_4, and increase linearly with a further increase of sulfuric acid concentration. (SJR)

29082 SELECTIVE BINDING OF IONS BY POLYELECTROLYTE GELS. Volume Change Criterion. Boyd, G. E.; Bunzl, K. (Oak Ridge National Lab., TN). J. Amer. Chem. Soc.; 96: No. 7, 2054-2058(3 Apr 1974).

The volume changes, ΔV, which accompany the selective binding of ions in ion-exchange reactions at 25°C between aqueous electrolyte mixtures and polyelectrolyte gels were measured in an attempt to establish the range of applicability of the Katchalsky and the Rice–Harris theories. The ΔV for the exchange of singly charged ions in lightly crosslinked polystyrene type strong-acid or strong-base ion-exchanger gels were small and positive or negative depending on the nature of the ions. Large, positive volume changes were observed with multiply charged cations. In general, ΔV became more positive with increased gel crosslinking and with the strength of binding as measured by the decrease in the standard

free energy, ΔG°, in the ion-exchange reaction. Four types of ion-binding processes were distinguished: (a) field binding; (b) site binding via ion-pair formation; (c) structure-enforced binding; and (d) charge-transfer binding. Multiply charged cations (i.e., Ca^{2+}, Ba^{2+}, La^{3+}, Th^{4+}) were selectively bound as ion pairs in all gels. Field binding could be inferred only for the selective uptake of singly charged cations in the lightly crosslinked gel. (auth)

29083 NEW METHOD FOR SYNTHESIS OF STRONTIUM TITANATE. Motojima, K.; Enomoto, S.; Hoshino, A.; Senoo, M.; Shimooka, K. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 11, 685-688(Nov 1973).

A new method is presented for synthesizing strontium titanate. The reaction between strontium nitrate and meta-titanic acid or titanium dioxide (anatase or rutile) has been studied with use made of thermogravimetry and differential thermal analysis, and the compound produced was identified by x-ray diffractometry. A mixture of strontium nitrate and meta-titanic acid is converted to strontium titanate at about 600°C by an apparently endothermic reaction. This process can be applied advantageously to the preparation of sources of radiation and heat that utilize radioactive strontium obtained from nuclear fission products. (JA)

29084 CORRELATION BETWEEN THE PROPERTIES OF EXCITED STATES OF MOLECULES AND BIOLOGICAL ACTIVITY, AS RADIOSENSIBILIZATION AND CARCINOGENIC ACTIVITY. Popp, F. A. (Univ., Marburg, Ger.). Z. Naturforsch., 28c: No. 9/10, 517-522(Sep 1973). (In German).

A connection between the differences in electronic structure of 5-halogenated uracil derivatives and thymine and different radiosensitization is discussed. At the same time, the calculated energy change of the second and third excited singlet states for the particularly sensitizing substances 5-bromo-uracil and 5-iodo-uracil, compared with the remaining uracil derivatives is remarkable. In connection with different charge distribution, this difference may in principle cause different energy transport processes. This phenomenon is to be mentioned, which has been discussed in previous papers dealing with the different carcinogenic molecules 3,4-benzpyrene and 1,2-benzpyrene. (auth)

Isotope Effects

Refer also to abstract 29297.

29085 VIBRATIONAL SPECTRA AND NORMAL COORDINATE ANALYSIS OF CRYSTALLINE H_2O_2, D_2O_2, AND HDO_2. Arnau, J. L.; Giguere, P. A.; Abe, M.; Taylor, R. C. (Laval Univ., Quebec). Spectrochim. Acta; 30: No. 3, 777-796(Mar 1974).

A systematic investigation was carried out of the vibrational spectra of the hydrogen peroxide crystal and its deuterated analogue, using both ir and Raman spectroscopy, over the range 4000 to 50 cm^{-1}. Mixtures of the two isotopic species up to approximately 95% deuteration were also studied to identify the fundamentals of the hybrid molecule, HDO_2. Single crystals of hydrogen peroxide oriented along two of the three crystallographic axes were examined in the Raman effect with polarized laser light. The O-H stretching bands are remarkably narrow in the Raman spectra: $\Delta\nu(1/2) = 20$ cm^{-1} at -193°C compared with about 80 cm^{-1} in the ir. Nearly all the O-H stretching components predicted by the factor group analysis were observed but a satisfactory identification of all components of the OOH deformation modes could not be achieved. The O-O stretching frequency in D_2O_2 (872 cm^{-1}) is slightly higher than in H_2O_2 (871 cm^{-1}) contrary to expectations. The hydrogen bonds in the H_2O_2 crystal appear somewhat less strong (by about 10 to 15%) than those in ice. A normal coordinate analysis of the unit cell modes proved to be of considerable value in the assignment of observed frequencies. The values of the eleven principal force constants and the twenty interaction constants used to fit the 59 assigned frequencies appear reasonable and are comparable with values found for other hydrogen bonded systems. (auth)

29086 ELECTRONIC EFFECTS IN ELIMINATION REACTIONS. VIII. E2 Reaction of 2-Arylethyl Fluorides. DePuy, C. H.; Schultz, A. L. (Univ. of Colorado, Boulder). J. Org. Chem.; 39: No. 7, 878-881(5 Apr 1974).

The rates of bimolecular elimination from a series of 1-fluoro-2-arylethanes, 1,1-difluoro-2-arylethanes, and 1,1,1-trifluoro-2-arylethanes have been measured in tert-butyl alcohol using potassium tert-butoxide as the base. The absolute rate of the reaction and the Hammett ρ value for the elimination both increase with the number of fluorines. Values for the latter are +3.24 for the fluoride, +3.56 for the difluoride, and +4.04 for the trifluoride, indicating that the transition state is highly carbanionic in character, as is also indicated by a relatively low value of k_H/k_D. (auth)

29087 ISOTOPE EFFECT IN DIFFUSION OF ^{14}C-SUBSTITUTED BENZENES IN BENZENE, n-HEPTANE, n-OCTANE, AND CYCLOHEXANE AT 25°. Thornton, S. J.; Dunlop, P. J. (Univ. of Adelaide). J. Phys. Chem.; 78: No. 8, 846-848(11 Apr 1974).

Tracer diffusion coefficients are presented for ^{14}C-substituted benzenes of different molecular weights diffusing in benzene, n-heptane, n-octane, and cyclohexane at 25°C. The data, obtained with one magnetically stirred diaphragm cell, indicate that, in agreement with previous results, a small isotope effect is present in each system. (auth)

29088 ISOTOPE EFFECT IN ENERGY LOSSES FOR DEACTIVATING COLLISIONS OF TETRAFLUOROMETHANE WITH CHEMICALLY ACTIVATED FLUOROETHYL RADICALS $CH_2{}^{18}FCH_2$ AND $CD_2{}^{18}FCD_2$. Frank, J. P.; Rowland, F. S. (Univ. of California, Irvine). J. Phys. Chem.; 78: No. 8, 850-851(11 Apr 1974).

In the formation of $CH_2{}^{18}FCH_2$ and $CD_2{}^{18}FCD_2$ by addition of thermal ^{18}F to C_2H_2 and C_2D_2 in the presence of excess NaF_3, CF_4, and SF_6, a different ratio of $(D/S)_H/(D/S)_D$ (decomposition/stabilization) was found for CF_4 than that found for NaF_3 and SF_6. CF_4 was found to be a less efficient energy remover permitting the activated species to undergo further decomposition after one collision. The average energy loss per collision with CF_4 is less for $CD_2{}^{18}FCD_2$ than for $CH_2{}^{18}FCH_2$. In the strong collisions with NaF_3 and SF_6 the decomposition rate constant is a function only of the characteristics of the ^{18}F addition, but in the weak collisions with CF_4 the bath gas characteristics are a factor. (JSR)

29089 SOME PROPERTIES OF RUBIDIUM DIHYDROPHOSPHATE SOLUTIONS IN ORDINARY AND HEAVY WATER. Mishenko, A. V.; Rashkovich, L. N. (Moscow State Univ.). Zh. Neorg. Khim.; 18: No. 11, 2892-2897(Nov 1973). (In Russian).

Data were obtained on the density of RbH_2PO_4 in H_2O and $Rb(D_{0.8}H_{0.2})_2PO_4$ in $(D_{0.8}H_{0.2})_2O$. At each temperature it was found that the density was a linear function of the volume concentration ($C' = cd$). Here c is the mass % and d is the density ($d = A + Bc'$). The density is given as a function of temperature and concentration as follows: for RbH_2PO_4, $d = 1.0080 - 2.29 \times 10^{-4}\,t + (0.6798 - 2.39 \times 10^{-4})\,c'$ and for $Rb(D_{0.8}H_{0.2})_2PO_4$, $d = 1.0787 - 2.73\,10^{-4}\,t + (0.6769 - 1.72 \times 10^{-4}t)\,c'$. Here t is in °C. The density values are accurate to 1%. The density of saturated RbH_2PO_4 solutions is given by the following equation: $d_{sat} = 1.2806 + 0.0056\,t_{sat}$. For deuterated solutions the densities in contact with tetragonal and monoclinic crystals are given by the following expressions: d_{sat} (tetragonal) $= 1.4748 + 0.0054\,t_{sat}$, and d_{sat} (monoclinic) $= 1.5366 + 0.0039\,t_{sat}$. Here t_{sat} is in °C. The equivalent electrical conductivity Λ in $ohm^{-1}\,cm^2\,mol^{-1}$ is given as a function of the solution molarity M in moles/liter and temperature t in °C: for RbH_2PO_4, $\Lambda = 51.97 + 2.063\,t - (18.23 + 0.767\,t)\,M^{0.5}$ and for $Rb(D_{0.8}H_{0.2})PO_4$, $\Lambda = 46.71 + 1.42\,t - (17.56 + 0.432\,t)\,M^{0.5}$. The accuracy is 1.5% for ordinary water solutions, and 1.3% for heavy water solutions. (SJR)

29090 FORCE FIELD OF CYANOGEN FROM VIBRATIONAL SPECTRA OF ISOTOPIC SPECIES. Jones, L. H. (Los Alamos Scientific Lab., NM). J. Mol. Spectrosc.; 49: 82-90(1974). (LA-UR-73-749).

The Raman spectra of $(^{12}C^{14}N)_2$, $(^{13}C^{14}N)_2$, and $(^{13}C^{15}N)_2$ in the vapor phase were studied. From the isotope shifts of several levels the Fermi resonance constant, $W_{01000-0002^{\circ}0} = cm^{-1}$, was determined. The observed data, together with earlier infrared data, allow a determination of all the first order anharmonic corrections and thus of the fundamental harmonic frequencies. From these results, force constants and compliance constants of a general quadratic force field are calculated and discussed. (auth)

29091 MULTIPROTON CATALYSIS IN THE HYDROLYSIS OF 3,5-DINITROASPIRIN. Gandour, R. D.; Schowen, R. L. (Univ. of Kansas, Lawrence). J. Amer. Chem. Soc.; 96: No. 7, 2231-2234 (3 Apr 1974).

The uncatalyzed hydrolysis of the anion of 3,5-dinitroaspirin, shown by Fersht and Kirby to proceed at least in part through an anhydride intermediate, exhibits rate constants k_W^n in mixtures of deuterium oxide (atom fraction n of deuterium) and protium oxide (atom fraction $1 - n$ of protium) which are described by the equation $10^4\,k_W^n = 1.27\,[0.39(1 - n + 0.50n)\,(1 - n + 0.83n)^2 + 0.61\,(1 - n + 0.52n)]\ sec^{-1}$. The intermediate salicylic acetic anhydride anion apparently hydrolyzes both at the salicyl carbonyl (39%, by classical anhydride hydrolysis) and at the acetyl carbonyl (61%, with protic bridging to the phenoxy center). The observed solvent isotope effect of 2.2 (k_H/k_D) is a weighted average of the effects for salicyl attack (2.9) and acetyl attack (1.9) and is coincidently equal to the effect for aspirin itself, which reacts with simple intramolecular protolytic catalysis by carboxylate. (auth)

29092 PROTON AND DEUTERON MOBILITY IN NORMAL AND HEAVY WATER SOLUTIONS OF ELECTROLYTES. Roberts, N. K.; Northey, H. L. (Tasmania Univ., Sandy Bay, Australia). J. Chem. Soc., Faraday Trans., I; 70: 253-262(1974).

Proton and deuteron mobility in normal and heavy water solutions of some alkali halides (NaCl, KCl, KBr and KI) and tetra-alkylammonium bromides (where alkyl is Me, Et, Pr or Bu) is measured polarographically and the diffusion coefficients calculated from a corrected Ilkovic equation. The results are analyzed in terms of the effect of electrolyte concentration on the excess or Grotthuss mobility of the hydrogen and deuterium ion. The results raise some questions about the accepted mechanism for the transport of the proton and deuteron in solution. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 29104.

29093 (LA-UR-74-429) LASER INDUCED RECOVERY OF DEUTERIUM OR TRITIUM FROM WATER. Jensen, R. J.; Lyman, J. L. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 9p. (CONF-740416-1). Dep. NTIS $4.00.

From 2nd European electro-optics conference; Montreux, Switzerland (2 Apr 1974).

A laser method for recovery of deuterium or tritium from water is proposed. The two-step photolysis method utilizes a known coincidence of the $P_1(8)$ line of the DF laser with HDO and D_2O absorption lines coupled with a water filtered xenon flash lamp to selectively photolyze HDO and D_2O in the presence of H_2O. CO is to be added to the photolysis mixture to remove the O atom from the OH photolysis product. The isotopic material is to be collected as D_2. The reaction kinetics for this experiment has been modeled with a computer calculation based on rate processes. The dependence of isotopic selectivity on various vibrational energy transfer processes is discussed. (auth)

29094 SYNTHESIS AND PROPERTIES OF HETEROFULVENES, DERIVATIVES OF 2,6-DIMETHYL-γ-PYRONE AND -γ-THIAPYRONE AND N-BUTYL-2,6-DIMETHYL-γ-PYRIDONE. Belsky, I.; Dodiuk, H.; Shvo, Y. (Tel Aviv Univ., Israel). J. Org. Chem.; 39: No. 7, 989-995(5 Apr 1974).

Oxygen-, sulfur-, and nitrogen-containing heterofulvenes, derivatives of 2,6-dimethyl-γ-pyrone (1) and -γ-thiapyrone (2) and N-butyl-2,6-dimethyl-γ-pyridone (3), have been prepared, and their properties are reported. The O and S heterocycles were prepared by condensation of 1 and 2, respectively, with active methylene compounds in acetic anhydride. The N heterocycles were obtained from the O heterocycles by reaction with butylamine. Side reactions were observed when butylamine reacted with methyl 2,6-dimethyl-4H-pyran-4-ylidenenitroacetate (6) and 2,6-dimethyl-4H-pyran-4-ylidenenitroacetone (5). A new convenient route to heterofulvenes which bear a single substituent at the exocyclic double bond was developed. Thus, heterofulvenes substituted by an acetyl group at the exocyclic double bond were found to undergo acetyl cleavage, under very mild acidic conditions, resulting in the formation of monosubstituted heterofulvenes. Deuterium exchange reactions in the systems under consideration were studied. The NMR, UV, and IR data of the disubstituted and monosubstituted heterofulvenes are discussed in terms of the heteroatom and the substituents at the exocyclic double bond. (auth)

29095 SEPARATION OF URANIUM ISOTOPES BY CHEMICAL EXCHANGE. Ogle, P. R. Jr. (to United States Atomic Energy Commission). US Patent 3,794,716. 26 Feb 1974. Filed Date 13 Sep 1972. 10p.

A chemical exchange method is provided for separating ^{235}U from ^{238}U comprising contacting a first phase containing UF_6 with a second phase containing a compound selected from the group consisting of $NOUF_6$, $NOUF_7$, and NO_2UF_7 until the UF_6 in the first phase becomes enriched in the ^{235}U isotope. (Official Gazette)

Feed Materials Processing

Refer also to abstracts 29157, 29288, 29995, and 31425.

29096 (INIS-mf-1074) PRODUCTION OF URANIUM CONCENTRATES FROM LOW GRADE ORES. Kamat, K. D.; Murthy, T. K. S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The principal production methods employed for recovering uranium concentrates from low grade ores are described. The acid leaching method for solubilizing uranium from the ores and the ion exchange and the solvent extraction techniques for further concentrating it from resultant leach solutions are discussed. The important features of the process followed at the uranium mill at Jaduguda, which has a capacity to treat 1000 tons per day ore containing 0.6-0.7 kg U_3O_8 per ton, have been described. Possibilities of recovering uranium as by-product have been indicated. (INIS)

29097 OPERATING EXPERIENCE IN THE J.E.N. WITH A FLUIDIZED BED PILOT PLANT. Rodrigo Otero, A.; Gonzalez Garcia, V. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 17: No. 86, 407-415(1973). (In Spanish).

Inherent difficulties in the expansion to industrial scale of fluidized bed production of UF_4 from the calcination of uranyl nitrate followed by reduction and fluorination are discussed. Experience acquired in operation of a pilot plant has shown that problems appear, some unpredictable, only after many hours of operation. It is practically impossible to carry out a scale increase with certainty. (23 references) (JSR)

29098 PURIFICATION PROCESS FOR RECOVERING URANIUM FROM AN ACIDIC AQUEOUS SOLUTION BY pH CONTROL. Fox, J. S.; Koetting, J. D. (to Union Carbide Corp.). US Patent 3,790,658. 5 Feb 1974. Filed Date 15 May 1970. 6p.

A process for obtaining purified uranium values from an acidic aqueous solution contaminated with iron, vanadium, phosphorus, and sodium values by selectively precipitating the contaminants through acidity (pH) control of the solution is described. (Official Gazette)

29099 POST OXIDATION PROCESS FOR URANIUM DIOXIDE RICH COMPOSITIONS. Dada, A. G.; De Hollander, W. R.; Sloat, R. J. (to General Electric Co.). US Patent 3,790,493. 5 Feb 1974. Filed date 6 Apr 1971. 10p.

A process is presented for converting gaseous UF_6 to an oxide. The process comprises introducing to a reaction zone in the presence of an active flame maintained in the reaction zone, a first gaseous reactant comprising a mixture of UF_6 and an oxygen-containing carrier gas and a second gaseous reactant comprising a reducing gas and temporarily separating the first and second gaseous reactants with a shielding gas which temporarily prevents substantial mixing and reaction between these gaseous reactants. The first and second gaseous reactants ultimately react to give a particulate UO_2 rich composition in the presence of residual reducing gas. An oxygen-containing gas as a third gaseous reactant is introduced at a time when the UO_2 conversion to the UO_2-rich composition is substantially complete. This results in oxidizing the UO_2-rich composition to a higher oxide of uranium with conversion of the residual reducing gas to its oxidized form. This process is adaptable to yield oxide products of uranium in any state of oxidation between UO_2 and U_3O_8. (Official Gazette)

29100 PROCESS FOR LANTHANIDE AND ACTINIDE METALS ORE REDUCTION. Taylor, P. F. US Patent 3,791,815. 12 Feb 1974. Filed Date 13 Dec 1972. 4p.

The ores or oxides are subjected to a certain liquid formula solution, such material being finely pulverized, by mixing together within a suitable container, followed by additions of pulverized limestone and stirred while the reaction goes to completion. The liquid formula is comprised of phosphoric acid, zinc oxide, and an alkylphenol polyglycol ether type sulfated surfactant. The mixture is heated within the container by an endothermic heat source until the ore has been digested by the liquid formula solution with the consequent release of gasses and expanded in volume to a dry, spongelike state. In this condition the material is considered as being "fixed" for smelting. Upon smelting the material releases the metal, which forms into ingot-like masses at the bottom of the furnace as reduced and smelted metal. The combination or reduction ingredients are effective, therefore, in liberating the metals from chemically bound oxygen and other impurities on heating the mixture and then smelting the residue. (Official Gazette)

29101 IMPROVEMENT OF THE PURIFICATION OF URANIUM USING AMINES. Takada, S. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Nippon Kogyo Kaishi; 89: No. 1022, 255-258(Apr 1973). (In Japanese).

Ningyo-toge quarry has been engaged in research and development with a pilot plant since 1964, in order to develop smelting technique for domestic uranium ore. The purification operation for uranium by means of solvent extraction and Amex hydrochloric acid transformation in PNC process is described. This method is conducted at first by bringing leached solution in contact with the organic solvent of 0.1 to 0.2 mol tri-n-octylamine in kerosene and 3 to 6% octanol to extract uranium in organic phase. Next, this organic solvent containing uranium is brought into contact with 8 mol HCl solution in counter-flow to transform

uranyl sulfate complex anion to uranyl chloride complex anion: $(R_3NH)_4UO_2(SO_4) + 6HCl \rightarrow (R_3NH)_2UO_2Cl_4 + 2R_2NHCl + 3H_2SO_4$, and the impurity involved in the organic phase transfers to water phase. Finally, the transformed organic phase is brought into contact with water to dissolve the uranyl chloride in water phase as follows: $(R_3NH)_2UO_2Cl_4 \rightarrow UO_2Cl_2 + 2R_2NHCl$. The organic solvent separated from the uranyl is recycled. In case of the Amex HCl transformation in ADU production, a branch was formed on the way of PNC process, and H_2SO_4 washing step was added to produce the purified ADU. After the extraction with amine, the uranium-containing solvent is brought into contact with 1/10 to 1/5 quantity of 0.1 mol H_2SO_4 in counter-flow to make amount of Fe and others 30 to 40 ppM by two stage washing. In order to maintain uranium concentration in uranyl chloride solution as high as possible, it is desirable to operate so as to minimize the extraction of HCl ions in organic phase in the transformation step. (JA)

Radiation Chemistry

Refer also to abstracts 29391, 29497, 29664–29666, and 29703.

29102 (AEC-tr-7226-5-6) NUKLEONIKA. Translated from Nukleonika; 17: No. 5-6, 259-350(1972). 82p. (TT-71-54027-5-6). Dep. NTIS $5.45.

29103 (INIS-mf-948) RADIATION CHEMISTRY OF DNA. de Jong, J. (Vrije Universiteit, Amsterdam (Netherlands); Interuniversitair Reactor Instituut, Delft (Netherlands); Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). Dec 1972. 67p. (In Dutch). INIS.

The effect of ionizing radiations on DNA in the living cell can be twofold: the direct effect consisting of ionizations in the DNA, and the indirect effect consisting of damage to the DNA by radicals generated in the surrounding medium. An attempt was made to obtain information about the possibility and importance of secondary reactions (i.e. the reactions between the organic radicals and DNA). Because of the complexity of the cell it is necessary to work with a simplified model. For model solutions dilute solutions of DNA were chosen in which relatively large concentrations of other compounds (such as amino acids) are present. Possible inactivation of ΦX174 DNA by secondary radicals formed in the course of these reactions was investigated. It was concluded from the experiments that radicals formed from phenylalanine in both oxic and anoxic conditions are capable of DNA inactivation. It was also concluded that the secondary reactions of the phenylalanine radicals most probably do not lead to strand break in the DNA but to other types of damage in DNA nucleotides. The DNA protection by tryptophan or histidine is such that secondary reactions have to be postulated, provided that oxygen is absent during irradiation. In case dissolved oxygen is present, the DNA will presumably be inactivated by water radicals only. The addition of small portions of cysteamine or p-nitroacetophenone to mixtures of DNA and one of the three amino acids mentioned, resulted in strongly increased protection of DNA in the anoxic condition. Biologically active double-stranded DNA (ΦX174 RF-DNA was used) can also be inactivated by amino acid radicals, but biological repair is possible partly, provided that irradiation is carried out in the absence of oxygen. In fact, it was found that the biological activity as determined with Uvr^+ spheroplasts (taken from two mutants of Escherichia coli), of the DNA irradiated under N_2O in the presence of any of the three amino acids, always was considerably higher than the activity as determined with the mutant. Thus, part of the damage caused in the RF-DNA is being repaired in the wild-type bacteria. From the results it was concluded that the repairable damage must be caused by the amino acid radicals. The irradiation sensitivity of DNA, as determined on Pol^- spheroplasts, appeared to be greater than that with the wild-type bacteria under any of the above mentioned conditions of irradiation. (INIS)

29104 (ORO-4062-13) ELECTRON–ELECTRON DOUBLE RESONANCE INVESTIGATIONS OF IRRADIATED ORGANIC CRYSTALS: THE INFLUENCE OF DEUTERIUM SUBSTITUTION. Kispert, L. D.; Chang, K.; Wang, P. S. (Alabama Univ., University (USA). Dept. of Chemistry). 1973. Contract AT(40-1)-4062. 25p. (CONF-731067-1). Dep. NTIS $3.25.

From Southeastern magnetic resonance conference; Tuscaloosa, Alabama, USA (Oct 1973).

Electron-electron double resonance (ELDOR) investigations of irradiated organic crystals have shown promising uses of deuterium substitution in the ELDOR identification of magnetically different radicals associated with a poorly resolved ESR spectrum Replacement of the water of crystallization in potassium acetate crystals with deuterium oxide has removed the proton spin-flip lines in the ELDOR spectrum of the methyl radical and has permitted fewer ELDOR combination lines from magnetically different radicals to be observed at 77°K. A study of the hydrogen–deuterium exchange reactions in irradiated glycine-d_3 and l-alanine crystals has shown the absence of ELDOR lines at the deuteron hyperfine frequency a_D and the absence of hydrogen–deuterium combination lines, but the presence of an intense line at the proton hyperfine splitting frequency. In addition a significant decrease in the intermolecular cross exchange near room temperature permitted a separation of the proton ELDOR spectra for each hydrogen–deuterium exchange reaction making it possible to identify the different simultaneously occurring reactions. (auth)

29105 MATERIAL BALANCE AND ADDITIONAL EFFECT OF SECOND ORGANIC SOLUTES IN THE RADIOLYSIS OF AQUEOUS METHIONINE SOLUTION. Tajima, M.; Morita, M.; Fujimaki, M. (Tokyo Univ.). Agr. Biol. Chem. (Tokyo); 36: No. 7, 1129-1134 (Jul 1972).

The gamma radiolysis of methionine in 10^{-3} M aqueous solution was studied. From the yield vs. dose plots, the following values were obtained: G(-methionine) = 3.0, G(methionine sulfoxide) = 0.30, G(α-aminobutyric acid) = 0.46, G(3-methylthio propylamine) = 0.59, G(methional) = 0.08, G(carboxylic acid) = 0.24, G(mercaptan + disulfide) = 0.61, G(ammonia) = 1.48, and G(carbon dioxide) = 1.45. From these results, it was concluded that major reaction was deamination and decarboxylation by OH radical attack. Addition of methanol as the second solute at concentration above 4×10^{-3} M could not lower G(methionine sulfoxide), suggesting the reaction of methionine with the secondary radical produced from methanol. The existence of a similar reaction was suggested in the radiolysis of methionine in aqueous pork extract. (auth)

29106 RADIOLYSIS OF FERROUS AMMONIUM SULPHATE IN ALKALI NITRATE AND ALKALI HALIDE MATRICES. Khare, V. S.; Ramshesh, V.; Venkateswarlu, K. S. (Bhabha Atomic Research Centre, Bombay). Radiat. Eff.; 20: No. 3, 153-157 (Nov 1973).

Radiolysis of ferrous ammonium sulfate (FAS) dispersed in (a) alkali nitrates [KNO_3, $NaNO_3$, $Ba(NO_3)_2$, $CO(NH_3)_6(NO_3)_3$] (b) alkali halides [KCl, KBr] and (c) binary mixtures of above [KNO_3 + KCl, $Ba(NO_3)_2$ + $BaCl_2$] was extensively investigated. FAS becomes oxidized and Fe^{3+} formation seems to depend upon the nitrate concentration and gamma dose but is independent of halide concentration. Mössbauer studies confirm these findings and it appears that basic ferric sulfate may be formed during the oxidation process. (auth)

29107 RADIATION STABILITY OF POLYCONDENSATION ION-EXCHANGE RESINS BASED ON FURFURAL. Askarov, M. A.; Dzhalilov, A. T.; Nazirova, R. A.; Tsveshko, G. S. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 9, 2250-2252(Sep 1973).

Translated from Zh. Prikl. Khim.; 46: No. 9, 2115-2117(Sep 1973).

The radiation stability of furan cation exchangers based on the products of interaction of furfural with salicylic acid, of furfural with p-toluenesulfonic acid, and of furfural with β-naphthalenesulfonic acid, and of an anion exchanger based on polyethylene polyamine, furfural, and hydrofuramide was investigated. Results show that the cation exchanger based on salicylic acid and furfural and the anion exchanger have greater radiation stability than the sulfonated exchangers; however, all of the polycondensation ion exchangers can be used in fields with a high radiation level. (LK)

29108 RADIATION-EMULSION POLYMERIZATION OF STYRENE WITH A HIGH CONCENTRATION OF LATEX PARTICLES. Lukhovitskii, V. I.; Lebedeva, A. M.; Karpov, V. L. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. A; 15: No. 11, 2465-2469(Nov 1973). (In Russian).

It was shown that in radiation-initiated polymerization of styrene the specific rate of polymerization does not depend on the number of latex particles up to a concentration of 10^{16} particles/ml, which is different from the situation with the use of material initiators. It is suggested that when water-soluble initiators are at a concentration of more than 10^{14} particles of latex per ml the drop in the specific rate of polymerization is the result of transfer of the chain to the initiator. (tr-auth)

29109 EFFECT OF GAMMA RADIATION ON PHASE TRANSITION AND MELTING POINT OF POLYVINYLIDENE FLUORIDE CRYSTALLITES. Gal'perin, E. L.; Kosmynin, B. P. Vysokomol. Soedin., Ser. A; 15: No. 11, 2556-2560(Nov 1973). (In Russian).

X-ray diffractometry, including high temperatures, was used in studying the formation of α- and β-form crystallites and their melting point in poly(vinylidene fluoride) samples with different initial structures subjected to γ-irradiation. It was shown that, in the α structures, the alpha-beta transition started at a dose of about 500 Mrads. The melting point of the β crystallites in the

irradiated samples was higher than that of the α crystallites and depended on the initial conformation of the macromolecule. Depending on the structure of the poly(vinylidene fluoride), irradiation with doses of 500 to 1000 Mrads and more, with subsequent crystallization from the melt or cyclohexanone solution, gave the β form rather than the α. The behavior of polyvinylidene fluoride samples with different initial structures is discussed. (tr-auth)

29110 CHARGE SCAVENGING IN γ RADIOLYSIS OF CYCLOHEXANE SOLUTIONS OF CARBORANES. Thibault, R. M.; Hepburn, D. R. Jr.; Klingen, T. J. (Univ. of Mississippi, University). Contract AT(40-1)-3781. J. Phys. Chem.; 78: No. 8, 788-792(11 Apr 1974).

The ^{60}Co γ radiolysis of cyclohexane solutions of o-carborane and 1-ethyl-, 1-vinyl-, and 1-allyl-o-carborane was studied for solute concentration in the range 0.5-200 mM. The value of $G(H_2)$ decreases with increase in solute concentration and values of the ion scavenging coefficient α of 33 M^{-1} for o-carborane and 1-ethyl-o-carborane and 10.6 M^{-1} for 1-vinyl- and 1-allyl-o-carborane were calculated, suggesting efficient electron scavenging by these solutes. Lower limits for the ratio of the specific rate of hydrogen abstraction from cyclohexane to the specific rate of addition to 1-alkenyl-o-carboranes is estimated for the hydrogen atom to be 0.0031 for 1-vinyl-o-carborane and 0.002 for 1-allyl-o-carborane. Yields of cyclohexene, dicyclohexyl, and cyclohexyl addition products with the 1-alkenyl-o-carboranes are consistent with electron and radical scavenging. The ultraviolet absorption spectra of the o-carboranes is discussed and the possibility of energy transfer from electronically excited cyclohexane to the o-carborane solutes is suggested. The results are related to previous studies of radiation-induced addition polymerization of 1-alkenyl-o-carboranes. (auth)

29111 SOLVATED ELECTRONS IN ALCOHOL–ALKANE AND ALCOHOL–AMINE SOLUTIONS. Brandon, J. R.; Firestone, R. F. (Ohio State Univ., Columbus). Contract AT(11-1)-1116. J. Phys. Chem.; 78: No. 8, 792-796(11 Apr 1974).

The absorption spectrum of the solvated electron formed by pulse radiolysis of solutions of ethanol in 3-methylpentane, 2,2-dimethylbutane, and neopentane is unaffected by the presence of these alkanes above a few mole per cent of ethanol at room temperature. Above about 20 mol % solvated electron yields per unit of absorbed energy increase in the same order as the radiolytic free-ion yields of the pure alkanes. Below about 10 mol % this order is reversed and the half-time for decay of the solvated electron at constant solution composition also decreases with increasing extent of chain branching in the alkane constituent. Similarly, the solvated electron yield in dilute solutions of methanol, ethanol, and cyclohexanol in neopentane decreases with increasing hydrocarbon character of the alcohol constituent. In ethanol–ethylenediamine solutions the amine is, to the contrary, the dominant solvating agent. These observations are discussed in the context of preferential solvation of excess electrons by microscopic aggregates of alcohol molecules and destabilization of these aggregates by alkanes and ethylenediamine. (auth)

29112 CHEMICAL REACTION RATES OF QUASI FREE ELECTRONS IN NONPOLAR LIQUIDS. Allen, A. O.; Holroyd, R. A. (Brookhaven National Lab., Upton, NY). J. Phys. Chem.; 78: No. 8, 796-803(11 Apr 1974).

A method is described for determining reaction rates of molecules dissolved in nonpolar liquids with electrons produced by ionization of the solvent. It is based on modification by the added substance of the current-growth curve which is seen when the liquid, in an electric field, is suddenly exposed to X-rays, and which is used for mobility determination by the Hudson method. The rate constants for recombination of electrons with positive ions, determined by the Langevin method in n-pentane, n-hexane, and tetramethylsilane, are diffusion controlled and hence proportional to the electron mobilities; this rate constant in tetramethylsilane is 5×10^{10} M^{-1} sec^{-1}. The electron reactions with CCl_4, CH_3I, and O_2 are not diffusion controlled; the rates are generally higher in solvents which show higher electron mobilities, but the increase is less than proportional. Different behavior is shown with C_2H_5Br; the electron reaction rate is lower in the high-electron-mobility solvents neopentane and tetramethylsilane than in hexane or 2,2,4-trimethylpentane, and its temperature coefficient, which is positive in hexane, becomes unexpectedly negative in the former solvents, and amounts to -1.7% per degree in neopentane. New electron mobility determinations are reported for methylcyclohexane, n-hexane, n-pentane, cyclohexane, neopentane, and tetramethylsilane. (auth)

29113 RADIATION-INDUCED POLYMERIZATION OF ACRYLAMIDE IN AQUEOUS SOLUTIONS USING ^{85}Kr SOURCE. I. Ootsuka, N.; Yamamoto, T. (Japan Atomic Energy Research Inst., Gunma). Oyo Butsuri; 42: No. 12, 1185-1191(Oct 1973). (In Japanese).

The polymerization of acrylamide in aqueous solution was carried out with β-irradiation facilities using unsealed ^{85}Kr gas as an internal radiation source. Irradiation experiments were made in a reaction vessel of 1-liter capacity with 290 Ci of ^{85}Kr. The effects of dose rate, monomer concentration, and polymerization temperature on the polymerization rate were studied. The experimental results were compared with the results using ^{137}Cs as a source. It is observed that the polymerization rate, for either source, is proportional to the 0.55th power of dose rate and the 1st power of monomer concentration. In addition, the activation energy of polymerization is 1.8 kcal/mol. It can be considered that there is no particular distinction in the polymerization rates due to difference in the radiation source. (auth)

29114 PRODUCTION OF INORGANIC SUBSTANCE–PLASTIC COMPOSITE MATERIALS UTILIZING RADIATION. Studies on Feasibility. Iwai, T. (Ube Industries, Ltd., Yamaguchi, Japan). FAPIG (Tokyo); No. 68, 244-251(Feb 1973). (In Japanese).

While the production of new high-polymer materials from monomers is somewhat deadlocked recently, efforts, on the other hand, are continued to produce inorganic substance-plastic composite material utilizing radiation in this procedure. Most is still in the stage of research and development. Some developments in this field are described: (1) utilization for polymerization: polymer-impregnated concrete, and gypsum-polymer composite; (2) utilization for hardening: resin concrete, and red mud-plastic; (3) utilization for cross-linking: polyethylene-alumina blend and polyethylene-kaolin blend; (4) utilization for graft polymerization to inorganic materials. (JA)

29115 RADIATION TREATMENT OF ADHESIVE TAPE. Matsushita, M.; Suzuki, F. (to Sumitomo Electric Industries Ltd.). Japanese Patent 1973,11341. 5 Nov 1965. 3p. (In Japanese).

Polyvinyl chloride is mixed with epoxidated fatty acid ester, and then the mixture is molded in the shape of a sheet. The mixture is irradiated by electron beams or gamma rays, etc., so that the polyvinyl chloride may be crosslinked by the epoxidated fatty acid ester. The irradiated sheet is coated with an adhesive and then cut in the shape of a tape to form adhesive tape. The epoxidated fatty acid ester used as the crosslinking agent may give the polyvinyl chloride based sheet a heat resisting, solvent resisting, and electric insulation property. In an example 100 parts by weight of polyvinyl chloride resin is mixed with ethylene oxide as a plasticizer, ~6% of oxygen and 50 parts by weight of the epoxidated soybean oil which corresponds to the ester of glycerin and epoxidated unsaturated fatty acid having a molecular weight of about 1000. The mixture is rolled with a calender to form the tape having a thickness of 0.1 mm. The tape is irradiated (at a dose of 35 Mrad) by the electron beams from an accelerator and then coated with the adhesive of the vulcanized rubber type to form the adhesive tape. (JA)

29116 PLASTIC PLASTICIZER AND RADIATION. Sunada, T. (Radiation Center of Osaka Prefecture, Sakai, Japan). Genshiryoku Kogyo; 19: No. 5, 40-43(May 1973). (In Japanese).

Examination concerning the possibilities of decomposition of plasticizers such as phthalic acid esters and phosphoric acid esters or toxicity reduction thereof by the radiation has been made. (1) Radiation effects: Sham polluted solution having various kinds of concentrations of said ester was irradiated with ^{60}Co γ-ray to 0.3 Mrad/hr. The results show that with the pollution of 10 times of a maximum pollution 0.3 ppM of DBP at present, destruction of more than 99% is shown with the irradiation of 0.01 Mrad. (2) Toxicity of irradiated plasticizer: The test was conducted on gold fish, and the result including DBP and TBP is that death rate of the gold fish is almost zero in the irradiation of 0.01 Mrad/hr, but a problem with respect to accumulation effect of minute quantity of ester inside the body must be solved. (3) Solubility from plastics sterilized by radiation: although it is necessary to know the difference in resolution quantities between the ordinary products and the plastic products which have been subjected to radiosterilization treatment, but in some experiments, no difference is recognized in the resolution quantities thereof. However, this testing method has many problems and no conclusion has been reached yet. (JA)

29117 RUBBER AND RADIATION. III. Polymerization, Graft Polymerization, and Radiation-Resistant Rubber. Takahashi, Y. (First Atomic Power Industry Group, Tokyo). FAPIG (Tokyo); No. 69, 50-56(May 1973). (In Japanese).

Following on the previous review of radiation cross-linking of rubber in radiation chemistry, four other aspects are described:

(1) radiation polymerization of diene monomers; (2) radiation graft-polymerization of rubber (including also the graft polymerization of the diene monomers to plastics as recent development); (3) block copolymerization; and (4) radiation-resistant rubber. For the industrial operation of radiation chemical reaction, it is necessary for the reaction concerned to complete at low dosage. To obtain good physical properties of products with high yield, the chemical reaction with the unsaturated bond of polymers is a means, as indicated in the hardening of polyester or the radiation treatment of paint. As an example, the block copolymerization of liquid polymers by radiation is presented. Radiation-resistant rubber practically useful is already available. (JA)

29118 PRODUCTION OF CONDENSATION NUCLEI BY ALPHA RADIATION. Burke, T. P.; Scott, J. A. (University Coll., Dublin). Proc. Roy. Irish Acad., Sect. 73A: No. 11, 151-158(1973).

Previous investigators have shown that condensation nuclei can be generated when air is irradiated by α-particles. The present study, confirming this, shows that a certain ionization intensity is required before nucleus production can be detected. The nucleus concentration at times varied erratically. This does not appear to be due primarily to the presence of trace gases nor can a direct relationship be established between the production rate and the humidity of the sample. Organic vapors were found to have a marked effect on the nucleus concentration and depending on the concentration of the vapor in the sample, the formation of the nuclei could be completely inhibited. (auth)

29119 RADIATION HARDENING OF LOW CONDENSATION PRODUCTS CONTAINING AMINO GROUP. Okamura, S.; Hayashi, K.; Kaetsu, I. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973,14793. 7 Nov 1967. 4p. (In Japanese).

An initial condensation product is prepared by condensing a monomer selected from the group of urea, thiourea, melanine, aniline and acidamide with formalin. One or more of the initial condensation product is then mixed with a substance which forms an acid or base by irradiation with an ionizing radiation in the presence or absence of the initial condensation product, except for halogenated hydrocarbon. The mixture is hardened by irradiation of the ionizing radiation to form a resinous substance. Formamide, acetamide, oxalic diamide, succinic diamide, acrylamide, etc. can be used as the acidamide monomer. Phosphonitrile chloride, cyanuric chloride, chloral hydrate, trichloroacetic acid, monochloroacetic acid, ammonium chloride, aluminium chloride, gaseous chlorine, sulfurous acid gas, sodium sulfite, aluminium sulfate, potassium hydrogensulfate, sodium pyrophosphate, potassium pyrophosphate, potassium phosphate, ammonia, bromine, bromal, bromal hydrate, dibromoacetic acid, sulfonated benzene, sulfonated toluene, etc. can be used as the acid- or base-forming substance. To the initial condensation product may be added 0.5–20%, in certain cases 20–50%, by weight of the said substances. The ionizing radiation can be electron beams. In an example, 2% chloral hydrate was homogeneously dissolved in the initial urea-formalin condensation product having a degree of condensation of 3–5. The solution was then irradiated by gamma rays at the dose rate of 4×10^4 r/hour from a ^{60}Co source with a dose 5.0×10^6 roentgens. A white resinous composition was obtained. (JA)

29120 PROCESS FOR PRODUCING A FOAM BODY BY CROSSLINKING VINYL CHLORIDE RESIN. Nishikawa, A.; Hosokawa, M.; Honda, T. (to Sekisui Chemical Co. Ltd.). Japanese Patent 1973,4863. 30 Sep 1969. 4p. (In Japanese).

A crosslinked vinyl chloride foam body is economically provided that is self-fire extinguishing, elastic, heat resistant, insoluble in solvent, and capable of secondary processing properties as well as the inherent properties of vinyl chloride by the action of ionizing radiation on a composition consisting of a foaming agent of usual decomposition type and one of the copolymers consisting of vinyl chlorides and ethylene or polyethylenes, subsequently the composition is heated above the decomposition temperature of the foaming agent. The efficiency of cross-linking is particularly excellent within the range between 1 and 40%, preferably between 5 and 20%, of polyethylene or ethylene for polyvinyl chloride resin. In one example, 100 parts by weight of vinyl chloride and ethylene copolymer, 10 parts of vinyl acetate and ethylene copolymer, 2 parts of basic lead sulfite, 0.5 parts of calcium stearate, 30 parts of dioctyl phthalate and 15 parts of azodicarbonamide as a foaming agent were mixed and extruded into a sheet of 2 mm in thickness and 120 mm in width out of a 40 mm extruder at 130°C. The sheet was caused to generate foam by electron-beam irradiation in air at 220°C for 3 min at a dose of 3, 6, or 12 M rad. The produced foams were independent of one another and excellent in cushion performance. (JA)

29121 COATING COMPOSITIONS. Maruyama, T. (to Kansai Paint Co. Ltd.). Japanese Patent 1973-15727. 8 Jun 1970. 4p.

Coating compositions are made by a process which comprises mixing the coating compositions which can be hardened by ionizing radiations with at least one compound (called A) selected from the group of the general formula, $M(NH_4)PO_4 \cdot nH_2O$, wherein M is Mg, Ca, Sr, Ba, or Co, and n is an integral of 1 to 10. The process is useful to reduce the irradiation dose required for the hardening of coating compositions. The blending proportion of the compound (A) to the solid component of the resin may be 1 to 60%, preferably 5 to 30%, though 1 to 20% for maintaining clearness by weight. The coating compositions applied to the substrates made of woods, metals or plastics are hardened by irradiation with ionizing radiations, preferably accelerated electron beams, beta-rays and gamma-rays from a source of accelerators, ^{90}Sr, ^{60}Co or ^{137}Cs, 0.6 mole of phthalic acid, 0.4 mole of tetraphthalic anhydride, 8.05 moles of propylene glycol and 0.2 mole of diethylene glycol are thermally condensated to produce an unsaturated polyester resin of acid value 3. 120 parts of thus obtained unstaturated polyester resin, 0.02 part of hydroquinone and 80 parts of styrene polymer are fused to produce an unsaturated polyester-resin composition (I). 100 parts of composition (I) are blended with 5 g of $Mg(NH_4)PO_4$ or the like to produce the coating compositions of unsaturated polyester resin in this invention. The applied coatings 100 μ thick are hardened by irradiation with 2, 4, or 6 Mrad electron beams from a 300-keV accelerator. (JA)

29122 pH EFFECTS ON THE PULSE RADIOLYSIS OF DEOXYGENATED AQUEOUS SOLUTIONS OF SULPHUR DIOXIDE. Eriksen, T. E. (Royal Inst. of Tech., Stockholm). J. Chem. Soc., Faraday Trans., I; 70: 208-215(1974).

Dilute deoxygenated aqueous solutions of sulfur dioxide and its related anions HSO_3^- and SO_3^{2-} in the pH range 2 to 11 were pulse irradiated and the time dependence of the transient optical absorptions and electrical conductance recorded. Hydrogen atoms and OH radicals abstract hydrogen from HSO_3^-. Also OH radicals react with SO_2 and SO_3^{2-} to form the radical ion SO_3^- with an absorption maximum at 225 nm. The SO_3^- radical ions recombine to form sulfate (SO_4^{2-}) and dithionate ($S_2O_6^{2-}$), the reaction rate and relative proportions of products being pH dependent. In acid solutions the SO_2^- radical ion with an absorption maximum at 360 nm is also formed, presumably by reaction of hydrogen atoms with sulfur dioxide. The SO_2^- radical ions recombine to form dithionite ($S_2O_4^{2-}$). (auth).

29123 INTERMEDIATES IN THE NANOSECOND PULSE RADIOLYSIS OF TRIPHENYLAMINE SOLUTIONS IN CYCLOHEXANE. Zador, E.; Warman, J. W.; Luthjens, L. H.; Hummel, A. (Interuniversitair Reactor Institut, Delft, Netherlands). J. Chem. Soc., Faraday Trans., I; 70: 227-236(1974).

The pulse radiolysis of solutions of triphenylamine (TPA) in cyclohexane has been investigated using nanosecond time resolution. In addition to the transient absorption at 620 nm which has been previously observed in microsecond pulse radiolysis and which is assigned to the N-phenyl-dihydrocarbazole (DHC) derivative, the following species have been identified: singlet TPA, fluorescence maximum 365 nm, mean lifetime 4.5 ns; triplet TPA, absorption maximum 520 nm, mean lifetime 38 ns; triplet N-phenyldihydrocarbazole, absorption maximum 430 nm, mean lifetime 330 ns; the TPA^+ radical cation, absorption maximum 640 nm. The rate constants for the reaction of TPA^1, TPA^3 and DHC^3 (where ^{1} and ^{3} refer to singlet and triplet, respectively) with O_2 have been measured to be 1.8×10^{10}, 1.3×10^{10} and 7×10^9 M^{-1} s^{-1} respectively. For a 10^{-2} M TPA solution the yield and decay kinetics of TPA^+ ($\epsilon_{640} = 14000$ M^{-1} cm^{-1}) are the same as found for the biphenyl negative ion in a 10^{-2} M biphenyl in cyclohexane solution. The effects of NH_3 and N_2O on the yields of intermediates indicate ion recombination following charge scavenging by TPA to be the major source of TPA^1 and TPA^3. (auth)

29124 PULSE RADIOLYSIS AND POLAROGRAPHY: INFLUENCE OF THE DOUBLE LAYER CAPACITY ON ELECTRODE REACTIONS OF SHORT-LIVED RADICALS IN AQUEOUS SOLUTIONS. Bansal, K. M.; Henglein, A.; Janata, E.; Sellers, R. M. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Ber. Bunsenges. Phys. Chem.; 77: No. 12, 1139-1144(Dec 1973).

The polarograms of free radicals measured in the 10^{-5} s range often show distortions caused by strong changes in the differential capacity of the double layer. This effect is discussed for the radicals produced by OH attack on benzene, benzyl alcohol, and t-butanol. The observation of these distortions leads to the conclusion that the relaxation of the double layer is very fast, i.e., occurs within a time shorter than a few microseconds. The time dependence of polarography currents in the 10^{-5} s range can be influenced by two effects at the Hg drop electrode: (1) The action of the double layer as an "electrical condenser" for ion pairs produced in elec-

trode processes with high transfer rates, and (2) the action of mercury as an "adsorption condenser" that stores free radicals by chemisorption at low transfer rates. A few observations on the catalysis of the cathodic reaction of the t-butanol radical, x $CH_2C(CH_3)_2OH$, by H^+ ions are also reported. A mechanism is proposed where the reduction of the protonated radical is accompanied by rapid elimination of water yielding isobutene. (GE)

29125 APPLICATION OF IONIZING RADIATION TO THE TREATMENT OF WASTE WATERS AND SEWAGE SLUDGE. Matsumura, T. (Radiation Center of Osaka Prefecture, Sakai, Japan). Nizu Shori Gijutsu; 14: No. 2, 197-204(Feb 1973). (In Japanese).

In the treatment of waste water and sewage sludge by ionizing radiation, opinion is varied as to its competitiveness with conventional methods. Past studies in this connection are reviewed. If polluting matter in sewage is irradiated and is changed to that of easy biological dissociation, it can lead to decrease of BOD or COD. To attain the effective dissociation at low dosage, large G value is necessary. Irradiation works in cooperation with the effect of chlorine or heat sterilization; sterilization of harmful germs in solid matter is also possible. Settling of sewage sludge is occasionally enhanced by irradiation. Concerning economic aspects the investment in facilities decreases with increasing capacity; however, operating cost is not much changed. For a plant of capacity 5×10^4 gallons per day, the construction cost and operating cost per 10^3 gallons are 0.55 and 0.3 dollar respectively. (JA)

29126 METHOD FOR THE PURIFICATION OF BIS(2-ETHYLHEXYL)PHOSPHORIC ACID. Schulz, W. W. (to United States Atomic Energy Commission). US Patent 3,793,408. 19 Feb 1974. Filed date 28 Jan 1972. 6p.

Foreign products including the neutral organophosphorous compounds and the iron salts normally present in commercial bis(2-ethyl-hexyl) phosphoric acid(HDEHP), and the radiolytic degradation products of HDEHP on exposure of HDEHP to beta and gamma irradiation are removed from HDEHP containing one or more of such products by contacting the said foreign product containing HDEHP with a macroreticular anion exchange resin in base form whereby the $DEHP^-$ ion of HDEHP exchanges with the anion of the resin and is thus adsorbed on the resin and the said foreign products are not adsorbed and will pass through a bed of particles of the resin. The adsorbed $DEHP^-$ ion is then eluted from the resin and acidified to form and recover the purified HDEHP. (auth)

29127 STUDIES IN RADIATION-INDUCED POLYMERIZATION OF VINYL MONOMERS AT HIGH DOSE RATES. II. Methyl Methacrylate. Allen, C. C.; Oraby, W.; Hossain, T. M. A.; Stahel, E. P.; Squire, D. R.; Stannett, V. T. (North Carolina State Univ., Raleigh). J. Appl. Polym. Sci.; 18: No. 3, 709-725 (Mar 1974).

The radiation-induced polymerization of methyl methacrylate was investigated with radiation sources of cobalt-60 and accelerated electrons at dose rates up to 3 Mrads/sec. Extrapolation of previous rates of polymerization at dose rates of 0.01-200 rads/sec coincided with the present results, the rates being approximately proportional to the square root of the dose rate throughout the entire set of dose rates measured. The molecular weights seemed to be independent of dose rate at the highest dose rates investigated. A combination of high polymer with a much higher molecular weight than expected was formed, together with a substantial portion of low molecular weight polymer. The reason for this behavior is not clear at this time. The G(M·) calculated from the molecular weights and fraction of polymer and resin was 6.0, which approaches that reported in previous investigations at low dose rates. There was no significant effect of air on the polymerization kinetics of methyl methacrylate at above 1 Mrad/sec. Nitrogen also did not influence the measured rates. Conversions to polymer were not substantially reduced by the presence of inhibitor at above 1.26×10^5 rads/sec. Water did not influence the rates of polymerization, except at the highest temperature (50°C) investigated. A large posteffect was observed in sealed degassed ampoules after 25% conversion to polymer. Only 3.4% additional polymer was formed in 24 hr after irradiation in the presence of air. The activation energy for the electron beam polymerization of methyl methacrylate was about 7.0 kcal/mole. This value, considering the complications in technique such as beam heating, did not differ from literature data enough to suggest any mechanistic difference in the polymerization at high dose rates. (auth)

29128 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF METHYL METHACRYLATE ONTO FLAKY GLASS SURFACE BY THE VAPOR-PHASE METHOD. Yoshioka, H.; Higshide, F. (Shizuoka Coll of Pharmacy, Oshika, Japan). J. Appl. Polym. Sci.; 18: No. 3, 939-941(Mar 1974).

Radiation-induced graft copolymerization onto the surface of a flaky alumino–silicate glass by the vapor-phase method was studied using DTA and ESR methods. Percentage of grafting of methyl metacrylate was found to be increased by chemical treatment with solutions of potassium permanganate and chromic acid mixture, while heat treatment of the samples lowered the value. The flaky glasses treated in various ways show the characteristic ESR spectra. It was thought that the structural defects formed on the glass have some correlations with the active sites of grafting. (auth)

29129 RADICAL ADDITION OF SECONDARY ALCOHOLS TO TRIFLUOROCHLOROETHYLENE AND CYCLIZATION OF FLUOROCHLOROALKANOLS UNDER THE FORMATION OF FLUORINATED OXETANES AND TETRAHYDROPYRANS. Liska, F.; Nemec, M.; Dedek, V. (Inst. of Chemical Technology, Prague). Collect. Czech. Chem. Commun.; 39: No. 2, 580-586(Feb 1974).

The tertiary alcohols obtained by the photochemically and γ-^{60}Co initiated addition of 3-methyl-2-butanol, cyclopentanol, and cyclohexanol to trifluorochloroethylene, were cyclized to fluorinated cyclic ethers by the action of aqueous sodium hydroxide. The cyclization is accompanied by intramolecular substitution of the chloro atom in the CHClF group. The 1:1 adducts afforded fluorinated oxetanes while fluorinated tetrahydropyrans (oxanes) were obtained from 1:2 telomers. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 31145.

29130 (CONF-730927-(Absts.)) XXIVth IUPAC CONGRESS, HAMBURG, GERMANY, SEPTEMBER 2–8, 1973. Abstracts of Papers. (Gesellschaft Deutscher Chemiker, Frankfurt am Main (F.R. Germany)). 1973. 304p. (In several languages).

The nine topics covered in this congress were: high polymers; chemistry of organic natural products; solid state chemistry; compounds of non-metals; applied electrochemistry; radiochemistry; information and communication in chemistry; medicinal chemistry; and modern methods for the treatment of waste water in theory and practice. (LK)

Hot-Atom Chemistry

29131 STUDY ON THE RECOIL PRODUCTS OF NEUTRON-IRRADIATED INOSINE-5′-PHOSPHATES BY PAPER ELECTROPHORESIS. Kitaoka, Y.; Kobayashi, M.; Takada, J. (Kyoto Univ., Osaka). Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 6: 18-23(Sep 1973).

Phosphorus-32 labeled recoil products of neutron-irradiated inosine phosphates were separated by a paper electrophoresis as well as by a paper chromatography. Experimental equations expressing the relationship between the mobility and the molecular weight or the dissociation constant were employed for the identification of their organic recoil products. The mechanism of the formation of recoil product is briefly discussed. (auth)

Properties of Radioactive Materials

Refer also to abstracts 29068, 29069, 29082, 29154, 29783, 29905, 29911, 31068, 31239, 31268, 31269, and 31374.

29132 (ANL-Trans-949) PREDICTION OF THE PROPERTIES AND OCCURRENCE OF ELEMENT 114. Hoffmann, P.; Baechmann, K. Translated from Radiochem. Radioanal. Lett.; 14: No. 3, 207-215(1973). 8p. Dep. NTIS $4.00.

Using an extrapolation method, the boiling point (950 to 1200°C), the heat of vaporization (23 to 29 kcal/mole), and the entropy of vaporization (18.7 to 21.2 cal/mole. deg) of element 114 were determined. Due to these results the geochemical behavior and the enrichment or depletion in technical processes are discussed. (auth)

29133 (CONF-720699-P3, pp 438-439) HUMAN SIDEROPHILIN LABELED WITH INDIUM-113m. Drouet, J.; de Verneuil, P. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The Hosain technique was used for the labeling of purified human plasma siderophilin (transferrin) with ^{113m}In. The sta-

bility of the product obtained was determined. The results show that this tracer is suitable for hemodynamic studies. (JSR)

29134 (KFK-1848) DEVELOPMENT OF A CLEANSER FOR DECONTAMINATION PURPOSES WITH CONTROLLED FOAMING CHARACTERISTICS. Kunze, S. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Dekontaminationsbetriebe). Dec 1973. 35p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

Comparative tests of the decontamination power of 1% aqueous cleanser solutions were carried out on contaminated stainless steel plates (material no. 1.4541) with stirring after fixed time intervals; the amount and stability of foam produced from aqueous solutions containing 0.5 and (partly) 10% of cleanser was measured at 20 and 100°C. For a further classification, the pH value and the residue after drying at 105°C and after incineration at 875°C of the cleanser were determined. The plates had been contaminated by evaporating to dryness a weakly acidic, carrier-containing solution of the isotopes ^{137}Cs, ^{45}Ca, ^{106}Ru, and ^{60}Co. The substances tested include the household, industrial and laboratory cleanser used in the nuclear research center, metal cleansers and decontamination agents and some commercial cleaning agents. The results regarding decontamination power and foaming were only partly satisfactory. Variations of composition of the best fit non-ionic detergent solutions gave preparations showing moderate foaming at low temperatures, low foaming at high temperatures. Strong formation and high stability of foam at elevated temperatures were demonstrated to exist in the case of the anionic sodium alkylsulfonate which is still contained in many cleansers. The influence of additions of complexing agents and of pH on the decontamination power of the non-ionic detergent mixtures with controlled foaming was studied on various surfaces. The complex formers included formic, gluconic, lactic, oxalic, thioglycolic, tartaric, citric acid, disodium-dihydrogenethylenediaminetetraacetate (EDTA-Na_2), and sodium orthophosphate. The solutions were investigated in the pH range between 3 and 9 on PVC floor covering, epoxy resin coatings, and stainless steel (material no. 1.4541). Based on these results, a new decontaminating agent called "Papan-Dekopan 85" was developed. Its properties are included in the table of the cleansers tested; their dependence temperature and dilution is plotted in graphs. The product has successfully been used in the equipment decontamination at the Decontamination Department (ADB) as well as by the decontamination squad in action. It is produced under license by Max Morant, Aschau/Chiemgau. (auth)

29135 (KFK-1927) COMPLEXING KINETICS OF TRANS-PLUTONIUM ELEMENTS. El-Rawi, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). Jan 1974. 107p. (In German). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis. Submitted to Karlsruhe Univ. (West Germany). Faculty fuer Chemie.

The kinetics of the complexing of Am, Cm and Cf by aminopolycarbon acids were investigated by ligand exchange between the metal cation M^{3+} and the lanthanium complexes LaX. Ligands were: Diethylenetriaminpentaacetic acid (H_5DTPE), Ethylenediaminetetraacetic acid (H_4EDTA), N-Hydroxyethylethylenediaminetriacetic acid (H_3NHEDTA), Transdiaminocyclohexanetetetraacetic acid (H_4DCTA). The ligand exchange proceeds as a first order reaction in the presence of a surplus of LaX with the total rate constant k_T. A correlation giving the dependancy of the rate constants on the concentration of the reactants was found valid for all tested ligands. The same correlation applies for the forward reaction constant k_f of the ligand exchange. The constants a and b of the correlation are the partial rate constants of two different reaction mechanisms acting side by side; in the case of a, this is the direct reaction of Am(III) and LaX, and in the case of b, the hydrogen ion catalyzed dissociative reaction $LaX-(H^+) \rightarrow HX-(Am) \rightarrow AmX$. The constants and therefore the respective partial complexing rates increase in the order H_5DTPE < H_4EDTA < H_3NHEDTA. H_4DCTA reacts especially slowly, which must be ascribed to a steric hindrance of the formation of the chelating. The rate constant k_f of the formation reaction $Am^{3+} + HX \xrightarrow{k_f} AmX + H^+$ was calculated from the values of b. These decrease in the order H_5DTPE > H_4EDTA > H_3NHEDTA. Again H_4DCTA falls out of sequence; its k_f is especially low. The ratio of the rate constants k_f or b of all ligands decreases in the order Cf > Am > Cm. It is remarkable that Cm does not have the position between Am and Cf according to its atomic number. Apart from this numerically small anomaly the complexing rate rises with the atomic number, this is with the decreasing ionic radius. The values found for a and b are tabulated. (auth)

29136 (MLM-2108) TOPICS IN AQUEOUS PLUTONIUM CHEMISTRY. Silver, G. L. (Mound Lab., Miamisburg, Ohio (USA)). 15 Mar 1974. Contract AT-33-1-GEN-53. 43p. Dep. NTIS $4.00.

The general plutonium equilibrium problem is solved with logarithms and a logarithmic form of the plutonium characteristic equation is suggested. Other topics include numerical methods for estimating the equilibrium acidity in plutonium solutions, a characteristic equation for the iron-plutonium reaction, a method for finding some forbidden combinations of solution variables, and properties of plutonium-238 radiation concentration cells. (auth)

29137 (NP-19938, pp vp, Paper 13) STUDIES ON THE DECONTAMINATION OF RADIOACTIVELY CONTAMINATED WELL WATER. Aurand, K.; Wolter, R. (Bundesgesundheitsamtes, Berlin). Nov 1971. (In German).

Research programs on the decontamination of well water using ion exchange columns, special precipitation reactions, distillation apparatus, and organic and inorganic ion exchangers are summarized. The germ count in various decontamination columns and filters after extended operation is determined. The principles to be followed in the design and construction of equipment to be used in the routine decontamination of water by untrained personnel are outlined. (JSR)

29138 (ORNL-TM-4370, pp 454-471) THERMODYNAMICS OF MOLTEN-SALT SYSTEMS. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973-August 31, 1973. Part I.

Studies of the chemistry of tellurium in molten Li_2BeF_4 were initiated to acquire a more fundamental knowledge of the role that tellurium plays in the corrosion of metals in reactor systems, particularly molten-salt reactors. (LK)

29139 (TID-26487) SPECIALISTS MEETING OF DECONTAMINATION OF PLANT COMPONENTS FROM SODIUM AND RADIOACTIVITY, DOUNREAY EXPERIMENTAL REACTOR ESTABLISHMENT, THURSO, CAITHNESS, SCOTLAND, 9-12 APRIL 1973. Summary Report. (International Atomic Energy Agency, Vienna (Austria)). 1973. 290p. Dep. NTIS $16.50.

Nineteen of the twenty papers were abstracted and indexed separately for NSA. One paper has already appeared in NSA as 28: 20283. (JGB)

For abstracts of individual papers see: 29140-29153, 29222, 30090, 31239, 31268, and 31269.

29140 (TID-26487, pp 27-45) REMOVAL OF RESIDUAL SODIUM FROM LOOP COMPONENTS. Pomie, P. (CEN de Cadarache, St.-Paul-les-Durance, France). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9-12 April 1973.

Methods used for the removal of sodium from reactor components and rigs are discussed. Advantages and disadvantages of classical methods, including the use of alcohol, water jet, and steam cleaning, are presented. The high pressure atomized (water) method has been used successfully for in situ removal of inactive residual sodium from rigs. This method is considered to be adaptable to the removal of radioactive sodium. (JGB)

29141 (TID-26487, pp 47-55) SODIUM REMOVAL AND DECONTAMINATION FROM RESIDUAL RADIOACTIVITY. A General Survey of the Problem. de Fremont, R.; Pomie, P. (CEN de Cadarache, St.-Paul-les-Durance, France). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9-12 April 1973.

Factors that must be taken into consideration in the development of methods for the removal of sodium and decontamination of reactor components are discussed. Methods presently being used and those being considered are treated briefly. (JGB)

29142 (TID-26487, pp 57-73) REVIEW OF INTERATOM ACTIVITIES ON THE RECLEANING OF PLANT COMPONENTS FROM SODIUM. Buchholz, H.; Haubold, W. (INTERATOM, Bensberg, Ger.). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9-12 April 1973.

Since 1967, INTERATOM has been investigating the following methods for the removal of sodium from the components of sodium plants: moist gas cleaning, steam cleaning, alcohol cleaning, and cleaning by vacuum distillation. Plants on a technical scale for moist gas and vacuum distillation cleaning processes were designed and operated by INTERATOM. Operating experience of these systems, regarding the operating conditions, cleaning effects, time requirements and others, are reported. A brief review of the washing and decontamination plant of SNR 300 is given. (auth)

29143 (TID-26487, pp 75-77) WORK PERFORMED AT THE NUCLEAR RESEARCH CENTRE, KARLSRUHE. Dippel, T.; Stamm, H. H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe, Ger.). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

Results of tests on the removal of sodium from reactor components using methanol, ethanol, and propanol are reported. Steam was used for cleaning large components. Aspects of future work are discussed. (JGB)

29144 (TID-26487, pp 79-88) EFFECT OF SODIUM CLEANING AND SUBSEQUENT AIR STORAGE ON CLADDING MATERIALS. Casteels, F. (CEN, Mol, Belg.); Menken, G.; Soenen, M. 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

Exposure of components and materials to sodium results in changes of surfaces that are expected to induce further damages during the air storage or re-exposure to the sodium. In order to study the extent of potential damages, tests were performed with cladding tube samples that were cleaned by different methods after an integrated exposure of 3000 hours at 973°K, 5 m/sec, 10 ppM oxygen. A portion of the samples were removed, cleaned, inspected, and re-inserted for 10 exposure intervals of 300 hours each. Cleaning methods using water, steam, alcohol, and distillation (773°K) either with or without pre-distillation at 653°K were employed. The steam, alcohol, or water cleanings showed nearly no influence on the metal loss and selective corrosion, except that the pre-distillation induced a slightly deeper grain boundary grooving of a few micrometers. The distillation at 773°K resulted in a remarkable penetration of oxygen and sodium along grain boundaries into the material. Chromium, nickel, and even iron are leached out to the same depth. From burst tests at 973°K it can be postulated that the ferritic regions on the grain boundaries have the same effect as small cracks with the same depth. In the case of long time air storage after sodium exposure the total selective Cr–Ni-depleted region is damaged. The depth (d) is related to the tangential burst strength (G_t) and the strength (G_o) of the undamaged material by the relationship of ($d - 1/G_t^2 - 1/G_o^2$) for small cracks. In general the cleaning effects on structural materials are small, but after a half year air-storage period the selective corrosion regions suffer significant loss of strength. (auth)

29145 (TID-26487, pp 89-101) DECONTAMINATION FROM NON-RADIOACTIVE SODIUM OF PLANT COMPONENTS FOR REUSE. Bottiglioni, F. (CNEN, Bologna); Cervellati, A.; Lorenzini, L.; Tomassetti, G. 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

Experiments were conducted on the removal of sodium from circuits or plant parts prior to their maintenance. Ethanol gave satisfactory results in the washing of small components or delicate parts. In situ distillation gave good results in the cleaning of test sections and sampling devices. A commercial solvent CHIMEC-NR proved satisfactory for the cleaning of a PEC fast reactor fuel element hold-down device, although its action is slower than that of the alcohols, and greater volume is required. The use of nebulized water, sprayed water, or saturated steam gives more rapid and effective results in cases where components of considerable size and without delicate parts are to be washed. Steam, nitrogen, and steam–nitrogen mixtures were also used for cleaning. Simplicity in design of components (few pockets, corners, etc.) aids in the cleaning when solvents are used. (JGB)

29146 (TID-26487, pp 115-118) NON-RADIOACTIVE SODIUM DESTRUCTION AND CONTROL OF THE EFFLUENTS AT THE CNEN CENTRES OF CASACCIA AND BRASIMONE. Bottiglioni, F. (CNEN, Bologna); Tomassetti, G. 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

Sodium is burnt in water steam. The reaction products are partially eliminated through a chimney and partially conveyed into a storage pit filled with gravel and sand. A new plant for the process is described. (MCG)

29147 (TID-26487, pp 119-124) CLEANING OF PLANT COMPONENTS CONTAMINATED BY RADIOACTIVE SODIUM. Atsumo, H. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Japan). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

Loops from the primary cooling system of a sodium-cooled fast breeder reactor were dismantled and cleaned with alcohol. Major components of the loop were subjected to the same process. The cleaning liquid had the following composition: methanol (2%), ethanol (88%), and isopropanol (10%). Proper conditions as to protective clothing, cleaning apparatus and procedures, and radioactive waste disposal are discussed. (JGB)

29148 (TID-26487, pp 135-166) SUMMARY OF SODIUM CLEANING EXPERIENCE IN THE LMFBR PROGRAM, USA. Taylor, G. R.; Bishop, E. C.; Cooper, M. H.; Perrone, P. (Westinghouse Electric Corp., Madison, PA). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

Experience in the USA is reviewed as to the cleaning of several reactor components and systems, with examples and causes of successes and failures, and identification of areas where there is a need for further application engineering. Cleaning methods that make use of a moist inert gas, alcohols, or vacuum distillation are discussed. (JGB)

29149 (TID-26487, pp 181-188) IN-SITU STEAM/INERT GAS DECONTAMINATION OF A STEAM GENERATOR MODEL FOLLOWING A SODIUM/WATER REACTION TEST. Bray, J. A.; Simpson, J. M. (United Kingdom Atomic Energy Authority, Dounreay, Scotland). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

Various steps of the decontamination required to remove residual sodium and reaction products from the Super-NOAH rig following a sodium–water reaction test are discussed. The in situ process consists of three stages: draining of bulk sodium and reaction products, steam process, and water wash. A mixture of steam and nitrogen is passed into a heated system to react with the residual sodium. Hydrogen is evolved during this process; it is vented to the atmosphere through a flame arrestor. The caustic liquor that results is drained off, monitored, and disposed of. The system is then water washed. (JGB)

29150 (TID-26487, pp 189-192) REMOVAL OF NaK FROM REACTOR COMPONENTS. Davies, R. A. (United Kingdom Atomic Energy Authority, Dounreay, Scotland). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

Methods for the removal of Na or Na–K alloys from reactor components are discussed. Decontamination methods involving reactions with an alcohol, water, liquid NH_3, CO_2 and CO, and distillation are reviewed. Advantages and disadvantages of the methods are discussed. (JGB)

29151 (TID-26487, pp 193-204) REML EXPERIENCE OF CLEANING LARGE PLANT COMPONENTS CONTAMINATED WITH SODIUM. Higson, J.; Mathison, J. (United Kingdom Atomic Energy Authority, Risley, Eng.). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

The procedures used in REML to clean large components contaminated with Na are summarized. Steam cleaning is used for robust components with simple internal geometries where the risk of damage will not be great. Alcohol cleaning is used for complex components because of a milder reaction. Distillation is used on complex components where there is a need to retain experimental evidence which might be lost by chemical treatment. (JGB)

29152 (TID-26487, pp 219-232) DECONTAMINATION OF 6000 GPM SODIUM PUMP. Mathison, J.; Trevalion, P. A. (United Kingdom Atomic Energy Authority, Risley, Eng.). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

The 6000 gpm sodium pump has been removed from its test rig and decontaminated on two occasions. The steam cleaning procedure used and the experience gained are described. The quantity and distribution of undrained sodium on the pump were determined. It is estimated that a pump with similar geometry may have up to 20 kg of adhering sodium when removed from a reactor system after two years. This quantity may possibly be reduced to less than 1 kg by suitable design modification. (auth)

29153 (TID-26487, pp 233-238) REACTION OF SODIUM AND WATER/STEAM IN CAPILLARIES. Halstead, W. D. (Central Electricity Research Labs., Leatherhead, Eng.). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

Initial results are reported on a study being made on the effects of such parameters as temperature, pressure, and size and shape of reaction zone, on the rate of reaction of sodium and water/steam in fine capillaries. In the first series of experiments, water at 294° and 333°K, and steam at 370°K, 10^5 N m^{-2} pressure, were reacted with sodium contained in capillaries with internal diameters of between 0.06 mm and 2.50 mm. (JGB)

29154 EXTRACTION OF PROTACTINIUM BY AMINES FROM SULPHURIC ACID SOLUTIONS. Awwal, M. A. (Atomic Energy Centre, Dacca, India). Nucl. Sci. Appl., Ser. B; 6: 23-27(Oct 1973).

Cationic, anionic, and neutral species of protactinium were established by electrophoresis studies. Extraction of protactinium as a function of sulfuric acid, sulfate, and amine concentrations is reported. These results show that protactinium can be extracted from sulfate media with amines and that extraction is a maximum at an acid concentration of ~0.1 N. The extraction mechanism can be explained based on either anion exchange or by adduct formation. (auth)

29155 OXIDATION-REDUCTION POTENTIAL OF THE U(VI)/U(IV) SYSTEM AT THE ELEVATED TEMPERATURE. Nikolaeva, N. M. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 1, 14-20(Jan 1974). (In Russian).

The values of the uranic–uranous oxidation-reduction potential in a 0.29 to 2.0 m perchloric acid solution were determined at temperatures from 25 to 150°C. The values of the standard potential, equilibrium constant, and standard exchange isobaric potential for the reaction: $U^{4+} + 2H_2O \rightleftharpoons UO_2^{2+} + 4H^+ + 2e^-$ were calculated. The temperature dependence of the standard potential for the interval from 25 to 150°C may be expressed by the equation $E_t = 0{,}2718 - 0{,}002151\ (t - 25) + 6{,}87413 \cdot 10^{-6}\ (t - 25)^2$. (auth)

29156 PHASE DIAGRAM OF THE $MgCl_2$–$PbCl_2$–UCl_4 SYSTEM. Desyatnik, V. N.; Mel'nikov, Yu. T. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 101-103(1973). (In Russian).

The primary crystallization surface of this system was studied by differential thermal analysis. The phase diagram of this system is given in triangular coordinates. The $MgCl_2$ field occupies the greatest area. The 4 $PbCl_2 \cdot UCl_4$ field occupies the smallest area. The transition point of the $MgCl_2$–$PbCl_2$–UCl_4 system was found at a temperature of 376°C and a composition of 6 mol % $MgCl_2$, 68.0 mol % $PbCl_2$, and 26.0 mol % UCl_4. At this point a four-phase peritectic reaction takes place with the formation of 4 $PbCl_2 \cdot UCl_4$ and $MgCl_2$ from $PbCl_2$ and the above ternary eutectic. For compositions within the $MgCl_2$–$PbCl_2$–4 $PbCl_4 \cdot UCl_4$ triangle the process of crystallization ends with the disappearance of the liquid phase, and the solid phase of $MgCl_2$, $PbCl_2$, and 4 $PbCl_2 \cdot UCl_4$. The crystallization of all other melts ends with solidification of a eutectic according to the reaction $L \rightarrow MgCl_2 + UCl_4 + 4\ PbCl_2 \cdot UCl_4$ at a temperature of 340°C and a composition of the ternary eutectic of 4.0 mol % $MgCl_2$, 61.0 mol % $PbCl_2$, and 35.0 mol % UCl_4. These low-melting ternary eutectics can be used as electrolytes in the electrolytic production or refining of uranium. (SJR)

29157 TERNARY SYSTEM OF LITHIUM CHLORIDE, POTASSIUM CHLORIDE, AND URANIUM TETRACHLORIDE. Desyatnik, V. N.; Dubinin, B. V.; Raspopin, S. P. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 98-100(1973). (In Russian).

This system can be represented as a triangular concentration diagram with five crystallization fields: LiCl, KCl, K_2UCl_6, UCl_4, and Li_2UCl_4. The greatest part of the concentration triangle belongs to LiCl, KCl, and UCl_4 section, a significant part of whose area is occupied by the compound K_2UCl_6. All secondary ternary systems are simple eutectics. The LiCl–KCl–K_2UCl_6 crystallization field reduces to a ternary eutectic at 335°C with a composition of 29.7 mol % LiCl, 55.6 mol % KCl, and 14.7 mol % UCl_4. Another ternary eutectic was found at 250°C with a composition of 26.9 mol % LiCl, 34.1 mol % KCl, and 39.0 mol % UCl_4. The Li_2UCl_6–K_2UCl_6–UCl_4 crystallization field shows a ternary eutectic at 260°C with a composition of 26.0 mol % LiCl, 32.9 mol % KCl, and 41.1 mol % UCl_4. These low-melting eutectics can be used in the refining of uranium. (SJR)

29158 REACTION OF URANIUM MONOCARBIDE WITH ACID AND ALKALINE SOLUTIONS. Ermolaev, M. I.; Tishchenko, G. V. (Voronezh Technological Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 11, 1631-1633(1973). (In Russian).

The UC samples showed 94.4% U, total C of 4.9% and free C of 0.1%. The UC samples were decomposed in a closed system in 0.1 to 6.0 N hydrochloric, sulfuric and phosphoric acids, and also in 0.1 to 6.0 N KOH solutions. Decomposition was considered complete when no increase in gas volume could be observed over a period of 3 hr. All of the bound carbide was converted to hydrocarbons. The nature of the acid had no effect on the gas phase composition. An increase in acidity from 0.1 N to 6.0 N leads to a decrease in hydrogen evolution from ~12 vol. % to ~4 vol. %, and to an increase in methane formation from ~65 vol. % to ~82 vol. %. A chromatographic analysis for decomposition in 6.0 N HCl showed 3.4 vol. % H_2, 81.9% CH_4, 7.4% C_2H_6, 1.0% C_2H_4, 1.2% C_3H_8, 1.1% C_3H_6, 2.4% C_4H_{10}, and 1.7% C_4H_8. Decomposition in 6.0 N KOH gave the following analysis for the gaseous evolution products: 4.5 vol. % H_2, 68.0% CH_4, 20.5% C_2H_6, 0.4% C_2H_4, 2.3% C_3H_8, 0.9% C_3H_6, 3% C_4H_{10} and 0.6% C_4H_{10}. (SJR)

29159 PREPARATION OF CERTAIN ORGANIC COMPOUNDS LABELED WITH CARBON-14. Synroezhko, A. M.; Selivanov, N. T. (Leningrad Technological Inst.). J. Appl. Chem. USSR (Engl. Transl.); 46: No. 9, 2188-2191(Sep 1973).

Translated from Zh. Prikl. Khim.; 46: No. 9, 2066-2070(Sep 1973).

Chemical preparation of the following compounds is described: n-decane-$2C^{14}$, decanone-5-$5C^{14}$, decanone-5-$6C^{14}$, decanone-5-$4C^{14}$, decanone-3-$3C^{14}$, decanone-2-$2C^{14}$, 2-heptanone-$2C^{14}$, decanol-5-$4C^{14}$, decanol-5-$5C^{14}$, decanol-2-$2C^{14}$, decanol-4-$5C^{14}$, and 1-methylcyclohexane-$1C^{14}$. (LK)

29160 HYDROPEROXYL RADICAL REACTIONS. II. Cupric Ions in Modulated Photolysis. Electron Paramagnetic Resonance Experiments. Meisel, D.; Levanon, H.; Czapski, G. (Hebrew Univ., Jerusalem). Contract AT(11-1)-322. J. Phys. Chem.; 78: No. 8, 779-782(11 Apr 1974).

The reaction of $HO_2\cdot$ radicals with Cu^{2+} ions was studied using flash photolysis–epr techniques. Th(IV) ions were used as spin traps for $HO_2\cdot$ radicals and decay kinetics of the long-lived Th–$HO_2\cdot$ complex formed were studied in the presence of Cu^{2+} ions. It is concluded that a complex between Cu^{2+} and $HO_2\cdot$ results, the stability constant for which is found to be $5.1 \pm 1.0 \times 10^7$ M^{-1}, and the rate of its decomposition, yielding Cu^+ and oxygen, is 30 ± 5 sec^{-1}. (auth)

29161 PREPARATION OF ULTRAPURE UF_3. Berndt, U.; Erdmann, B. (Kernforschungszentrum, Karlsruhe, Ger.). Radiochim. Acta; 19: No. 1, 45-46(1973). (In German).

High-purity UO_2 or U_3O_8 (from Merck company) was converted to UF_4 by putting it in a nickel container for reaction with a purified gaseous mixture of HF (99.99%) and H_2 for four hours at a temperature of 600-700°C. The UF_4 was then reduced to UF_3 in the same device at 1020-1050 (±20)°C by changing the gas flow. (HK/CB) (GE)

29162 RADIOPHARMACEUTICALS. 12. A New Rapid Synthesis of Carbon-11 Labeled Norepinephrine Hydrochloride. Fowler, J. S.; MacGregor, R. R.; Ansari, A. N.; Atkins, H. L.; Wolf, A. P. (Brookhaven National Lab., Upton, NY). J. Med. Chem.; 17: 246-248(1974).

Norepinephrine labeled with ^{11}C can be synthesized by BH_3 reduction of cyanohydrin-^{11}C. (LK)

29163 CONTINUOUS PLUTONIUM DISSOLUTION APPARATUS. Meyer, F. G.; Tesitor, C. N. (to United States Atomic Energy Commission). US Patent 3,794,470. 26 Feb 1974. Filed date 6 Jun 1972. 6p.

This invention is concerned with continuous dissolution of metals such as plutonium. A high normality acid mixture is fed into a boiler vessel, vaporized, and subsequently condensed as a low normality acid mixture. The mixture is then conveyed to a dissolution vessel and contacted with the plutonium metal to dissolve the plutonium in the dissolution vessel, reacting therewith forming plutonium nitrate. The reaction products are then conveyed to the mixing vessel and maintained soluble by the high normality acid, with separation and removal of the desired constituent. (Official Gazette)

29164 RADIOCHEMICAL PURITY OF ^{99m}Tc-PERTECHNETATE. Billinghurst, M. W.; Groothedde, M.; Palser, R. (Health Sciences Centre, Winnipeg, Manitoba). J. Nucl. Med.; 15: No. 4, 266-269(Apr 1974).

The radiochemical purity of ^{99m}Tc-pertechnetate obtained from an automated methyl-ethyl-ketone extraction system is compared with that obtained from a commercial generator. The parent ^{99}Mo used in both systems was produced by neu-

tron irradiation of ^{98}Mo. The principal contamination in the product from the extraction system is shown to be ^{186}Re. A study of the amount of ^{186}Re in successive extractions shows that whereas submicrocurie amounts are present in the initial extraction, the amount of contamination drops rapidly to zero after the third extraction. In a similar study of the commercial generator, the principal contaminant is shown to be ^{134}Cs. The amount of this ^{134}Cs contamination is shown to increase with each elution of the generator. (auth)

29165 IMPROVED METHOD OF LABELING THYROID HORMONES WITH RADIOIODINE. Hallaba, E.; El-Shaboury, G. (Atomic Energy Establishment, Cairo). J. Nucl. Med.; 15: No. 4, 270-272(Apr 1974).

The parameters of the isotopic exchange reaction between nonradioactive thyroxine or triiodothyronine dissolved in ethyl alcohol with radioiodine extracted in ether were investigated. The effect of the concentration of carrier iodine on the yield of labeling as well as the different factors leading to its formation are discussed. A radiochemical yield of 95% ^{131}I-thyroxine is obtained within 10-15 min. The method is very simple and favorable for very short-lived radioiodines. (auth)

29166 KINETICS OF SOLID PHASE TRANSFORMATIONS IN THE $UF_4-NH_4F-H_2O$ SYSTEM AT 25°C. Koneva, L. G.; Borin, L. L. Zh. Neorg. Khim.; 18: No. 11, 3113-3115(Nov 1973). (In Russian).

On investigating the above system from two sides (from the side of UF_4 and $UF_4 \cdot 4NH_4F$), conditions for the existence of the following double salts of uranium tetrafluoride have been determined: $6UF_4 \cdot 7NH_4F$, $(NH_4)_2UF_6$ and $(NH_4)_4UF_8$. It has been shown that the rate of solid phase transformations depends on the concentration of ammonium fluoride. The kinetics of the transformations were studied by putting identical samples of NH_4F and UF_4 (or $UF_4 \cdot 4NH_4F$) in polyethylene vessels and thermostating at 25°C with agitation. After definite intervals of time the solid phase was carefully filtered off and analyzed. It was found that the transformation rate slows down on approaching the points of invariance. Thus, for example, not more than 30 min is required for the conversion of uranium tetrafluoride into the double salts $6UF_4 \cdot 7NH_4F$, $(NH_4)_2UF_6$ and $(NH_4)_4UF_8$ at regions far from the invariant point. However, at a concentration of 4.8% ammonium fluoride (that is, near the invariant point) the time to convert uranium tetrafluoride to $(NH_4)_2\ UF_6$ is 10 hr, while at a concentration of 32.6% ammonium fluoride, the conversion of UF_4 into $(NH_4)_2\ UF_6$ continues for days. The time for the conversion of $(NH_4)_4\ UF_8$ to $(NH_4)_2\ UF_6$ near the invariant point is 5 days, but the same conversion takes place instantaneously at an ammonium fluoride concentration less than 23%. In this case there is a direct relationship between the thermodynamic and kinetic characteristics of a process. It would be of interest to know how general this relationship is. (SJR)

29167 IMPROVEMENTS IN OR RELATING TO ^{14}C-LABELLED COMPOUNDS. Oldham, K. G.; Carr, N. G. (to United Kingdom Atomic Energy Authority). British Patent 1,342,098. 28 Dec 1973. Filed Date 12 Mar 1971. 4p.

A method is described for making ^{14}C-labeled nucleosides, nucleotides and amino acids by growing a microorganism of the germs Anacystis in a medium containing a high concentration of ^{14}C in a form in which it is taken up by the microorganism. The organism is then harvested after vegetative and reproductive growth, and the ^{14}C-labeled compounds recovered. The species Anacystis nidulans is stated to be very suitable for use in the method, and its advantages over other organisms are stated. The source of the ^{14}C is a medium containing $^{14}CO_2$ and/or $NaH^{14}CO_3$ of artificially high ^{14}C content. Separation processes are described. (UK)

29168 RADIOCHROMATOGRAPHY OF LABELLED COMPOUNDS. Sheppard, G. Review, No. 14. Amersham, Eng.; Radiochemical Centre (1972). 49p.

The booklet is designed to help users of radiochemicals who wish to carry out their own analyses or to interpret data on radiochemical purity. The subject is dealt with in sections entitled: preparation and elution of the chromatogram; artefacts caused during the preparation and elution of the chromatogram; measurement of the activity of the chromatogram; the accuracy of radiochemical purity values; and the significance of radiochemical purity values obtained from paper and thin-layer chromatography. (UK)

29169 THERMOGRAPHIC STUDY OF SYSTEMS CONTAINING UCl_3, $PuCl_3$, $CaCl_2$, $MgCl_2$. Vorobei, M. P.; Desyatnik, V. N.; Skiba, O. V.; Emel'yanov, N. M. Zh. Neorg. Khim.; 18: No. 11, 3060-3062(Nov 1973). (In Russian).

Differential thermometry was used to determine fusion points in two binary systems UCl_3-PuCl_3 and UCl_3-CaCl_2, and in two ternary systems $UCl_3-CaCl_2-PuCl_3$ and $UCl_3-MgCl_2-PuCl_3$. The UCl_3-PuCl_3 system is characterized by formation of a continuous series of solid solution whose crystallization is compressed on going from UCl_3 to $PuCl_3$. An inflection point was found at 80 mol % $PuCl_3$ with a melting temperature of 723°C. The UCl_3-CaCl_2 system is characterized by the formation of solid solutions having a limited solubility of the components. A eutectic is formed at a melting temperature of 630°C with 42 mol % UCl_3. The ternary system $UCl_3-MgCl_2-PuCl_3$ forms a eutectic having a melting temperature of 635°C and a component content of 28% $PuCl_3$, 27% UCl_3 and 45 mol % $MgCl_2$. The $UCl_3-CaCl_2-PuCl_3$ system is characterized by formation of a simple eutectic having a melting temperature of 595°C and a component content of 22% $PuCl_3$, 32% UCl_3 and 46 mol % $CaCl_2$. (SJR)

29170 DIPHTHALOCYANINE COMPLEX OF THORIUM. Kirin, I. S.; Koloyadin, A. B. Zh. Neorg. Khim.; 18: No. 11, 3140-3141(Nov 1973). (In Russian).

This compound $ThPc_2$ (Pc is $C_{32}H_{16}N_8^{2-}$) is obtained by reacting a triethylamine adduct of thorium chloride with phthalodinitrile. The adduct $ThCl_4 \cdot 2(C_2H_5)_3N$ is obtained by treating an alcoholic solution of $ThCl_4$ with an excess of $(C_2H_5)_3N$. The precipitate is centrifuged off. Excess $(C_2H_5)_3N$ is removed over H_2SO_4. Thorium diphthalocyanine is purified from extraneous reaction products by fractional sublimitation in a vacuum of 10^{-5} mm Hg std at 490-510°C. The yield is 12%. Calculated composition values (experimental values are in parenthesis) were: % C-61.14 (62.10); % H-2.55 (2.66); % N (by difference)-17.84 (16.71) and % Th-18.47 (18.53). The absorption spectrum has an intensive adsorption band with a maximum at 649 mm. Frequency maxima of infrared adsorption bands for $ThPc_2$ are: 729, 743, 773, 790, 813, 882, 944, 1000, 1070, 1115, 1163, 1182, 1285, 1308, 1330, 1386, 1405, 1422, 1451, 1475, 1505, 1584 and 1606 cm^{-1}. These values are close to the corresponding frequencies of UPc_2. The interplanar distances and line intensities of $ThPc_2$ and UPc_2 show a close similarity in the structures of these compounds. (SJR)

29171 SYSTEM $(NH_4)UF_8-NH_4F-H_2O$ AT 25°C. Koneva, L. G.; Borin, L. L. Zh. Neorg. Khim.; 18: No. 11, 3149-3151 (Nov 1973). (In Russian).

The initial materials were the double salt $(NH_4)_4UF_8$ and ammonium fluoride solutions of different concentrations. The $(NH_4)_4UF_8$ compound is obtained by treating uranium tetrafluoride with a saturated solution of ammonium fluoride. Stability of the precipitated double salts $(NH_4)_4UF_8$, $(NH_4)_2UF_6$ and $6UF_4 \cdot 7NH_4F$ was noted at ammonium fluoride concentrations of 45.1-33.1, 32.1-5.0, and 4.35-0.06%, respectively. Numerous experiments on synthesis of the double salt at 24.2% NH_4F concentration showed that $(NH_4)_2UF_6$ is formed under these conditions, and this double salt is not converted to $(NH_4)_4UF_8$ even after contact with the ammonium fluoride solution over a period of several months. In order to define more accurately the invariant points of the system, experiments were carried out on conversion of $(NH_4)_4UF_8$ to $(NH_4)_2UF_6$ under conditions where the initial and final salts coexist in the equilibrium precipitate. Analysis of the liquid phase showed that a 32.9% NH_4F concentration corresponds to the invariant point $(NH_4)_4UF_8-(NH_4)_2UF_6$. By analogous experiments on the conversion of $(NH_4)_4UF_8$ to an equilibrium mixture of $(NH_4)_2UF_6$ and $6UF_4 \cdot 7NH_4F$ it was possible to determine an NH_4F concentration of 4.4% at the invariant point $(NH_4)_2UF_6-6UF_4 \cdot 7NH_4F$. (SJR)

29172 PREPARATION AND CRYSTAL STRUCTURE OF SOME TELLURIDES OF NEPTUNIUM. Damien, D. (CEN de Fontenay-aux-Roses, France). J. Inorg. Nucl. Chem.; 36: No. 2, 307-308(Feb 1974). (In French).

In the Np-Te system, the following compounds have been identified: $NpTe_3$, $NpTe_{2-x}$ and η and γ Np_2Te_3. All these compounds are isostructural with their rare-earth and plutonium counterparts. $NpTe_3$ crystallizes in the orthorhombic, pseudoquadratic system ($a = b = 4.355 \pm 0.002$ Å and $c = 25.40 \pm 0.09$ Å). The ditelluride crystallizes in the quadratic system, with the Fe_2As type of structure ($a = 4.355 \pm 0.004$ Å and $c = 9.023 \pm 0.008$ Å at 700°C). ηNp_2Te_3 crystallizes in the orthorhombic system ($a = 11.89 \pm 0.02$ Å, $b = 12.21 \pm 0.02$ Å and $c = 4.369 \pm 0.005$ Å). γNp_2Te_3 possesses the b.c.c. Th_3P_4 type of structure with a lattice parameter $a = 9.4129 \pm 0.0004$ Å at 800°C. From the structural analogy between these compounds and the rare-earth, plutonium and ammonium tellurides and from the comparison between the corresponding lattice parameter values, it can be assumed that neptunium exhibits the +3 valency state in these chalcogenides except in the tritelluride where it should exhibit the +4 valency state. (auth)

29173 MACROMOLECULAR COMPLEXES FORMED AS THE RESULT OF CHLORMINE-T RADIOIODINATION OF PROTEINS.

Sherman, L. A.; Harwig, S.; Hayne, O. A. (Jewish Hospital, St. Louis). Int. J. Appl. Radiat. Isotop.; 25: No. 2, 81-85(Feb 1974).

Fibrinogen has recently been shown to form macromolecular aggregates during radioiodination with chloramine-T. Decreased half-lives of chloramine-T radioiodinated fibrinogen have also been noted. The effects of chloramine-T on fibrinogen fragment D, fibrinopeptide A, albumin and gamma G globulin were studied to determine if aggregation is unique to fibrinogen. With fragment D and albumin, ICl-labelled protein had identical column behavior to the unlabelled proteins. Chloramine-T labelled protein showed protein products of higher molecular weight than native Fg-D. Albumin was reacted with varying amounts of chloramine-T in the absence of iodide. In high C-T concentrations, there was significant production of higher molecular weight species. These results suggest that use of standard chloramine-T radioiodination may result in macromolecular species which would be unsuitable for in vivo purposes. It would seem desirable that any protein labelled with chloramine-T for in vivo studies should be examined for the presence of this type of subtle denaturation prior to use. (auth)

29174 ACCIDENTS WITH ATOM BOMBER AIRCRAFT. Hvinden, T. (Forsvarets Forsknings-Institutt, Kjeller, Norway). Sivilt Beredskap; 16: No. 4, 12-17(1973).

American bombers carrying nuclear weapons have crashed in Spain in 1966 and Greenland in 1968. Following a general introduction on the general radiological problems from such accidents, the decontamination work in each case is described in some detail. The difficulties in detecting the alpha radiation from plutonium-239 in the Spanish accident were accentuated in Greenland due to severe cold and new fallen snow. A new type of instrument measuring gamma radiation from the americium-241 daughter of plutonium-241 was therefore used, despite low temperature problems. In Spain the upper surface of the ground in the most contaminated zone was removed and shipped to USA, together with contaminated vegetation. The rest of the ground was deeply ploughed. Houseroofs and walls were hosed and walls painted. After 2 to 3 months the region could be taken into agricultural use and monitoring has shown insignificant contamination. In Greenland contaminated wreckage and snow were collected and sent to USA. Measurements on fish, birds, foxes, and seals showed no contamination that formed a hazard for the Eskimo population. Experience from these two accidents shows that it is possible to clear up even under very adverse conditions and to decontaminate and reoccupy an area in the course of some weeks or months. (NO)

29175 THERMOCHEMISTRY OF URANIUM COMPOUNDS. III. Standard Enthalpy of Formation of Cesium Uranate (Cs_2UO_4). O'Hare, P. A. G.; Hoekstra, H. R. (Argonne National Lab., IL). J. Chem. Thermodyn.; 6: No. 3, 251-258(Mar 1974).

The enthalpy of reaction of cesium uranate (Cs_2UO_4) with approximately 1 mol dm^{-3} HCl was determined by solution calorimetry to be $-(43337 \pm 65)$ cal_{th} mol^{-1}. Combination of this result with measured enthalpies of solution of CsCl(c) in HCl(aq) and of UO_2Cl_2(c) in an aqueous mixture of CsCl + HCl, together with auxiliary thermochemical data from the literature, gave a value of $-(453.46 \pm 0.85)$ $kcal_{th}$ mol^{-1} for the standard enthalpy of formation, $\Delta H_f^\circ(Cs_2UO_4, c, 298.15\ K)$. (auth)

29176 ESTIMATION BY SMEARING OF THE LEVEL OF TRITIUM SURFACE CONTAMINATION. Kitano, K.; Ikezawa, Y.; Harada, Y.; Kokubu, M.; Kajimoto, Y. (Japan Atomic Energy Research Inst., Tokai). Hoken Butsuri; 8: No. 2, 67-71(Jun 1973). (In Japanese).

For the estimation of tritium surface contamination by a smear technique, some experiments have been made on the optimum content of glycerol loaded in the smear paper, the fraction of tritium removed by the paper from the surface contamination (i.e., removal efficiency), the counting efficiency for a 2π gas flow counter, and the desorption of tritium from contaminated smear papers. Of the total contamination, 1% and 10% can be removed using a 25 w/o glycerol loaded smear paper from a permeable material such as synthetic polymer resin tile and a non-permeable one like stainless steel plate, respectively. The counting efficiency for a tritium smear sample is about 10% for the counter. It is therefore appropriate to assume that the overall counting efficiency in this method (removal efficiency multiplied by counting efficiency) is 0.1% and 1% for the above two materials, respectively. The desorption of tritium is much less from a glycerol loaded smear paper, being only 20% in 40 min, while it is as high as 70% from the non-glycerol loaded one. (auth)

29177 USE OF IR SPECTROSCOPY IN THE ANALYSIS OF LABELLED COMPOUNDS. Zilka, L. Radioisotopy; 14: No. 1, 225-244(1973). (In Czech.).

A survey of microtechniques used in the IR spectroscopy of radioactive substances and of spectra measurement methods is presented and examples of applications are described. (auth)

Radioactive Waste Treatment

Refer also to abstracts 29277, 29402, 29776, 30187, and 30194.

29178 (BNL-18731) SAVANNAH RIVER LABORATORY LONG-TERM WASTE STORAGE PROGRAM. Progress Report No. 4, January–February 1974. (Brookhaven National Lab., Upton, N. Y. (USA)). Mar 1974. 20p. Dep. NTIS $4.00.

A program was implemented at Brookhaven National Laboratory (BNL) in support of Savannah River Laboratory's (SRL) development program for long-term engineered storage of solidified high-level radioactive wastes. The FY 1974 BNL program objectives are (1) the preparation of appropriate formulations of cements with synthetic sludges, synthetic slurries and zeolites and (2) an evaluation of the properties of the radwaste-concrete composite materials. (auth)

29179 (INIS-mf-887-1, pp 25-36) NEW TECHNOLOGY OF RADIOACTIVE WASTE FIXATION INTO BITUMEN. Magyar, M.; Mozes, G. (Magyar Asvanyolaj es Foldgaz Kiserleti Intezet, Veszprem, Hungary). [nd]. (In Russian).

A new method is described of solidifying radioactive wastes into bitumen and the equipment is described for the fixation of aqueous solutions of radioactive wastes, mainly the aqueous solutions of radioactive wastes with a high content of nitrates (approximately 30 wt %). The technology described has of late been also extended to highly diluted radioactive wastes (of a concentration of the order of 0.05 wt %). The solidification is carried out in the installation reactor using a one-stage technique at a temperature of 200 to 250°C. Flow charts are presented of the intermittent and of the continuous bituminization. (INIS)

29180 (INIS-mf-887-1, pp 74-80) BEHAVIOR OF RADIOIODINE IN NUCLEAR POWER PLANTS. Hladky, E.; Pietrik, I.; Moravek, J.; Kubik, I. (Vyskumny Ustav Energeticky, Jaslovske Bohunice, Czech.). [nd]. (In Czech).

The results are briefly listed of the mathematical processing of methyl iodide formation in the course of nuclear power plant operation, and of a study into a possible application of an inorganic sorbent based on alumina (Al_2O_3) impregnated with silver nitrate. Two basic parameters were verified in the above filtration material, viz. the efficiency of the elemental radioiodine capture and of the methyl iodide capture. The block diagram is presented of the detection device for the control of radioiodine in stacks of nuclear power plants. The detector proposed consists of a plastic material vessel containing the filter bed (impregnated alumina). The vessel is inserted into a well-type scintillation crystal of 100 mm × 120 mm in dimensions, connected to the electronic evaluation apparatus NZQ 713. The efficient volume of the bed in the vessel is 220 ml. The gas sample passes through the filtration vessel and the activity of the captured radioiodine is continuously recorded. (INIS)

29181 (INIS-mf-936, pp 31-38) TREATMENT OF RADIOACTIVE CONCENTRATES. Napravnik, J. May 1973.

A combined method was developed for the fixation of highly radioactive concentrates, based on the emulsification of sludges with aqueous bitumen emulsions, their coagulation and subsequent separation of water in a screw separator followed by further evaporation of the remaining water in a heated housing. Another method used at present at NRI Řež is the solidification of radioactive concentrates into bitumen by evaporating a film of the aqueous suspension mixture or an emulsion of bitumens and sludges. Aqueous bitumen emulsions produced by Paramo, Pardubice (Czechoslovakia) were used for the purpose. Characteristics of the processes and parameters of materials used are summarized in tables. For wastes with an activity between 20 and 200 Ci/kg, a combined method of evaporating the mixture of radioactive cement concentrates with aqueous bitumen emulsions was developed on a laboratory scale. For portland cement and aqueous bitumen emulsions of the EAS-AS60 and EAS-KS60 type and bone glue as a protective colloid, the optimum ratio of the respective components was found for liquid wastes containing 600 g of $NaNO_3$ in 1 kg. The extraction rate of model salts was approximately 10^{-5} g · cm^{-2} · day^{-1}. (INIS)

29182 (INIS-mf-936, pp 39-46) HANDLING OF HIGHLY ACTIVE WASTES. Palkova, J.; Vojtech, O. May 1973.

The use of basalt as a fixation medium for highly active wastes was studied. Synthetic frits were prepared containing the basic components of basalt. Radioactive wastes were added to the frits,

resulting in a substance similar to basalt containing nepheline, forsterite, diopside, and anorthite. The ratio of components depended both on the type of the frit and on the type of radioactive wastes (characterized by a high content of Mg + Be and/or Mg + Al). The quality of the product depended considerably on the thermal treatment used. The optimum fixation process consisted in mixing crushed frit with liquid wastes, pre-drying the mixture at up to 600°C until nitrates decomposed, melting the mixture at 1250°C for 2 hr with subsequent cooling to 700°C, and adjusting the temperature of crystallization to 950°C. The product was maintained for 1 hr at this temperature and then slowly cooled. The composition of wastes considerably affected leachability. A special frit containing 2% of TiO_2 was used for wastes containing Al + Mg. The final product had a high hydrolytic resistance and after recrystallization it was resistant even to hot hydrofluoric acid. The main advantage of these synthetic substances was the possibility of adjusting the composition of the final product according to the original composition of the wastes and thus controlling the properties of the product. (INIS)

29183 (INIS-mf-936, pp 47-52) SEPARATION OF VALUABLE FISSION PRODUCTS AND TRANSURANIUM ELEMENTS FROM RADIOACTIVE WASTES. Kourim, V. May 1973.

A brief review is given of problems related to the application of fission product mixtures containing also transuranium elements. The most promising fields of application are: beta and gamma radiation sources, medicine, chemistry, food industry, space programs, and generation of electric power, heat, light, and of mechanical energy. Out of currently separated radionuclides, the most frequent are ^{137}Cs, ^{90}Sr, ^{144}Ce, ^{147}Pm, and the transuranium elements. (INIS)

29184 (ORNL-TM-4370, pp 412-453) CTR SUPPORTIVE RESEARCH. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

Studies related to tritium management in fusion reactor systems and to the recovery of tritium from liquid lithium and molten Li_2BeF_4 coolant-blankets were initiated. Equilibria in the hydrogen isotope–lithium systems are being measured to provide data necessary for evaluation of methods for recovering tritium from liquid lithium blankets. Initial studies were involved determining the pressure of hydrogen in equilibrium at high temperatures with LiH–Li solutions that have low LiH concentrations. Solubilities of H_2 and D_2 in molten Li_2BeF_4 were determined for the 773 to 973°K range and were found to be practically identical. Thus reasonable estimates of the solubility of T_2 in Li_2BeF_4 can be made. (LK)

29185 MANAGEMENT OF HIGH-LEVEL RADIOACTIVE WASTES BY VITRIFYING. Hoshino, T.; Tsuzuki, S. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan). Genshiryoku Kogyo; 19: No. 6, 38-44(Jun 1973). (In Japanese).

With the rapid advance of atomic energy utilization recovery and storage of radioactive wastes, instead of dilution and release thus far, is essential necessity. In fuel reprocessing plants, amount of high-level radioactive liquid wastes produced is very considerable. To cope with the problem, process of vitrifying is most suitable, because of little escape of contained radionuclides and good propertiesof heat conduction and radiation resistance. Reviewing first the world situation in this field and types of glass to be used, the vitrifying process currently available is described: namely spray and calcination, phosphate process, pot vitrification in the U. K., the U. S. and France, and rotary-furnace calcination method. (JA)

29186 METHODS OF REMOVING RADIOACTIVE RARE GASES. Nomi, M. (Ebara Mfg. Co. Ltd.). FAPIG (Tokyo); No. 66, 125-129(Aug 1972). (In Japanese).

Of radioactive rare gases, krypton and xenon are released in gaseous wastes from reactor operation or fuel reprocessing. When the wastes are released into the atmosphere without their removal, these radioactive gases produce hazards in later years. The four methods available to remove them and their respective characteristics are reviewed: (1) adsorption with active carbon, (2) separation at ultra-low temperature, (3) separation by selective permeability membrane, and (4) selective absorption in fluorocarbon. While world development in this field is varied from basic to pilot plant studies, it is desirable to store permanently long half-life species such as ^{85}Kr after separation. The method with active carbon is successful both at normal and low temperatures. The ultralow temperature treatment is employed in the ICPP of U. S. The method by selective permeability membrane is successful in the laboratory, but has not reached the stage of pilot plant yet. The selective absorption in fluorocarbon can be used extensively, more useful than any other method for the intended purpose. (JA)

29187 VOLUME REDUCTION OF RADIOACTIVE ION EXCHANGE RESINS FOR DISPOSAL. Calmon, C. (to Aerochem Research Labs., Inc.). US Patent 3,791,981. 12 Feb 1974. Filed Date 7 Apr 1971. 10p.

Ion exchange resins contaminated with radioactivate materials are reduced in volume for purposes of disposal by treating the contaminated resins with certain solvents having a dielectric constant of about 45 or lower. Solvents, such as, methanol, ethanol and acetone may be used to reduce the volume of the contaminated resins prior to storage and/or disposal. The method of this invention as applied to disposal of radioactively contaminated ion exchange resins reduces the space required for storage and/or burial of bulk quantities of this type of radioactive waste material, provides a self-sealing medium within the storage containers to prevent small leaks when the containers are stored in an aqueous medium, and promotes burning of the resin in cases where incineration is desirable. (Official Gazette)

29188 METHOD OF REPRESSING THE PRECIPITATION OF CALCIUM FLUOZIRCONATE. Newby, B. J.; Rhodes, D. W. (to United States Atomic Energy Commission). US Patent 3,781,217. 25 Dec 1973. Filed Date 3 Jul 1972. 4p.

Boric acid or a borate salt is added to aqueous solutions of fluoride containing radioactive wastes generated during the reprocessing of zirconium alloy nuclear fuels which are to be converted to solid form by calcining in a fluidized bed. The addition of calcium nitrate to the aqueous waste solutions to prevent fluoride volatility during calcination, causes the precipitation of calcium fluozirconate, which tends to form a gel at fluoride concentrations of 3.0 M or greater. The boron containing species introduced into the solution by the addition of the boric acid or borate salt retard the formation of the calcium fluozirconate precipitate and prevent formation of the gel. These boron containing species can be introduced into the solution by the addition of a borate salt but preferably are introduced by the addition of an aqueous solution of boric acid. (Official Gazette)

Radioisotope Production

Refer also to abstract 29732.

29189 (LBL-2446) RADIONUCLIDE GENERATORS: CURRENT AND FUTURE APPLICATIONS IN NUCLEAR MEDICINE. Yano, Y. (California Univ., Berkeley (USA). Donner Lab.; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 26p. (CONF-740203-7). Dep. NTIS $3.50.

From international symposium on radiopharmaceuticals; Atlanta, Georgia, USA (12 Feb 1974).

The rapid development of diagnostic nuclear medicine has been stimulated by the advances in instrumentation and in radionuclide generator systems. Generator-produced radionuclides provide a high flux of useful photons from short-lived radionuclides which are conveniently and economically obtained from their long-lived parent isotopes. A number of radionuclide generators are possible; however only a limited number are useful for scintigraphy. Developments in the ^{99m}Tc generator, either solvent extraction or alumina column, are presented together with some results of radiopharmaceutical preparations using $^{99m}TcO_4^-$ from various sources. Developments in the ^{113m}In and ^{87m}Sr generators as well as other less used generators are presented. Ultra-short-lived radionuclides such as ^{137m}Ba, ^{128}Cs, ^{82}Rb and ^{191m}Ir are discussed and their applicability to blood flow studies is presented. The use of high-energy proton beams at the BLIP and LAMPF facilities to produce curie amounts of parent radionuclides, which are now difficult to obtain, could aid in the development of ultra-short-lived radionuclide generator systems. (auth)

29190 (ORNL-4921) TRANSURANIUM PROCESSING PLANT SEMIANNUAL REPORT OF PRODUCTION, STATUS, AND PLANS FOR PERIOD ENDING JUNE 30, 1973. King, L. J.; Bigelow, J. E.; Collins, E. D. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 38p. Dep. NTIS $4.00.

This is the eleventh report in a series that is being issued semiannually to inform the heavy-element community of the status and future production plans of the Transuranium Element Production Program at ORNL. During the period January 1, 1973, through June 30, 1973, transuranium elements from 22½ irradiated HFIR targets and from 3 Pu–Al tubes that had been irradiated at the Savannah River Plant (SRP) were recovered as part of the Californium-I program to evaluate the commercial market for ^{252}Cf and to establish an inventory of material for sale. We purified 187 g of Californium-I curium and converted it to oxide for use in HFIR targets. Also, 1.8 μg of ^{254}Es, 3.24 g of ^{244}Pu, and 12 mg of ^{248}Cm, all of high isotopic purity, were recovered from materials previously processed. Sixty-four shipments were made

from TRU during the period; recipients and the amounts of nuclides are listed in Table 2.2 on pp. 5-7. Twenty HFIR targets, each containing 7 to 9 g of actinides (predominantly curium), were fabricated. During the next 18 months, we expect to recover totals of 49 mg of ^{249}Bk, 575 mg of ^{252}Cf, 2.3 mg of ^{253}Es (in a mixture of isotopes), 255 μg of isotopically pure ^{253}Es, and 1.5 pg of ^{257}Fm. Also, we expect to obtain 50 mg of high-purity ^{248}Cm from purified californium now in storage. Currently, we do not plan to process any of the remaining SRP Pu–Al tubes or to irradiate any plutonium targets in the HFIR; thus, we do not expect to recover any ^{244}Pu. Work was done during this period to improve one of our processing steps. A new batch solvent extraction process, using 60% TBP as extractant, was tested as an alternative to the Cleanex process. Three neutron sources were fabricated, bringing the total fabricated to 63; 5 sources that had been used in various projects were returned to TRU for reassignment or reprocessing. Tests were made to determine the containment classification for Zircaloy-2 encapsulated sources, and studies relative to neutron counter dead time were made to improve neutron source calibration. (auth)

29191 (SRARI-P-195) POSSIBILITY OF OBTAINING ENRICHED AMERICIUM-242g BY THE ELUTION OF RECOIL ATOMS FROM ZEOLITE. Shafiev, A. I.; Vityutnev, V. M.; Ivanov, V. M.; Yakovlev, G. N. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 9p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

On the example of production the possibility of obtaining enriched actinide isotopes by the elution of recoil atoms with the use of a zeolite-americium-241 target was shown. The enrichment factor and the recoil atoms of ^{242g}Am yield depend on preliminary target treatment and solution composition used for elution. (auth)

29192 PRODUCTION AND CONTROL OF PHARMACEUTICAL PREPARATIONS WITH SHORT-LIVED RADIOACTIVE ISOTOPES IN HOSPITALS. Braenne, H. Norsk Farm. Tidsskr.; 82: No. 2, 30-32(15 Jan 1974). (In Norwegian).

Following a brief description of the laboratory facilities, equipment, and personnel, the procedures for preparation of technetium-labeled compounds using a radioisotope generator are outlined. For brain, thyroid, and placenta scintiscanning the eluent is used without additive. For liver scintiscanning a Tc-sulphur colloid with a buffer and stabilizer is used, while a modified version of Cragins serumalbumin-macroaggregate method is used for lung scintiscanning. The quality control procedures are briefly described and finally general experience in the use of radioisotopes is summarized. (NO)

29193 RADIOACTIVE XENON SOLUTION. Lewis, R. E.; Hanson, L. A. (to General Electric Co.). US Patent 3,791,982. 12 Feb 1974. Filed Date 19 Jul 1972. 8p.

An aqueous solution having dissolved therein an isotopic mixture comprising natural xenon and a radioactive isotope of xenon is presented along with a method of preparing the aqueous solution. (Official Gazette)

29194 PROCEDURE FOR THE SEPARATION OF SUB-MICROGRAM QUANTITIES OF LEAD AND BISMUTH BY VACUUM EVAPORATION. Gries, W. H. (National Physical Research Lab., Pretoria). Mikrochim. Acta; No. 2, 249-256(1974).

A procedure has been developed for the separation of sub-microgram quantities of lead from similar amounts of bismuth by the preferential evaporation of lead chloride from a platinum surface in vacuum. Because separation is rendered inefficient with such small quantities by dominance of the differing adhesive bonding over the uniform cohesive bonds it was found necessary to use cadmium chloride as carrier. The separation achieved was better than is possible with a wet chemical method. The observations are described and discussed. (auth)

29195 PRODUCTION OF ^{28}Mg BY THE USE OF ELECTRON LINACS. Takeda, Y.; Shinozuka, T.; Itagaki, S.; Kotajima, K. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: No. 2, 158-160(Dec 1972). (In Japanese).

A 10-μCi yield of 21.3-hr ^{28}Mg can be obtained by the ^{30}Si(γ,2p)^{28}Mg reaction, where the γ rays are produced by 65-MeV bremsstrahlung. Starting material was 400 mg of 99.9% pure natural metallic silicon. Irradiation was made with bremsstrahlung of Eγ max = 40 to 65 MeV at intervals of 5 MeV for ~2 hr each for various energy levels. The irradiated samples were left for 2 hr to allow short-lived by-products to decay. Measurement of the γ-rays was made with a 33-cm^3 Ge(Li) detector. In the energy spectra thus obtained, 3 peaks of γ-rays at 0.40, 0.95, and 1.35 MeV, and a peak at 1.78 MeV were observed. These are attributable, respectively, to the decay of ^{28}Mg and ^{28}Al, which is the daughter nucleus of the ^{28}Mg. Maximum yield of the ^{28}Mg was found at Eγ max = 65 MeV. The yield was 7×10^{-1} μCi per Si 1g when 1g of the sample was used. It is possible to produce about 10 μCi ^{28}Mg if higher specific radioactivity is needed. (LK)

Reactor Fuel Reprocessing

Refer also to abstracts 29057, 29293, 29336, and 29491.

29196 (HW-31000(Del.)) PUREX TECHNICAL MANUAL. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 25 Mar 1955. Contract W-31-109-eng-52. 907p. Dep. NTIS $47.50.

Declassified 12 Mar 1974.

The manual is made up of 5 sections: Part I, Introduction; Part II, Process, which includes chapters on irradiated slugs and fission-product decay, feed preparation, process chemistry, process engineering, solvent-extraction procedure, concentration of uranium and plutonium solutions, aqueous make-up, solvent treatment, and acid recovery and waste disposal; Part III, Plant and Equipment, which includes chapters on general description of plant, pulse columns, other process equipment, pumps, jets, and agitators, remote operation and maintenance, and construction materials and protective coatings; Part IV, Process Control, with chapters on instrumentation and sampling and analytical methods; and, Part V, Safety, including chapters on health protection from radiation, radiation intensities and shielding, decontamination of surfaces, hazards other than radiation, critical mass control. An index is also included. (JGB)

29197 (ICP-1039) STABILITY OF COMPLEXED ROVER DISSOLVER SOLUTIONS CONTAINING HIGH CONCENTRATIONS OF NIOBIUM, FLUORIDE-ION, AND ALUMINUM. Rindfleisch, J. A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). Feb 1974. Contract AT(10-1)-1375. 19p. Dep. NTIS $4.00.

The processing of nuclear rocket (Rover) fuels requires high concentrations of hydrofluoric acid and nitric acid in the dissolver solution to dissolve the uranium and niobium. The resulting dissolver solution is highly corrosive and requires the addition of aluminum nitrate to complex the "free fluoride" and reduce corrosion on stainless steel processing equipment located downstream from the dissolver. The dissolver solution is very sensitive to aluminum nitrate addition; excessive aluminum nitrate results in precipitation of Nb_2O_5. Insufficient aluminum nitrate results in precipitation of AlF_3, and the solution remains corrosive. The stability range of the complexed dissolver solution is narrow and time dependent. The stability range was determined experimentally to vary from 24–30% for a 2-hr period and from 0–10% for a 24-hr period. The stability range is increased to 40% over a 5-day period when the solution is diluted and adjusted for solvent extraction feed. (auth)

29198 (ORNL-TM-4370, pp 398-411) CHEMISTRY OF RADIOIODINE. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

Development of a mercuric nitrate scrubbing process for removal of radioiodine from off-gases is reported. The most important recent finding is that the mercuric nitrate process is relatively ineffective for removing aromatic iodides from gas streams and that the presence of aromatic compounds interferes with removal of I_2 and methyl iodide. (LK)

29199 (ORNL-TM-4370) CHEMICAL DEVELOPMENT SECTION B SEMIANNUAL PROGRESS REPORT, MARCH 1, 1973–August 31, 1973. Part II. Scott, C. D.; Burtis, C. A.; Crouse, D. J.; Ferris, L. M.; Mailen, J. C.; Pitt, W. W. (comps.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. W-7405-eng-26. 69p. AT.

Contributions of Chemical Development Section B to the chemical development effort relative to LMFBR fuel reprocessing cover four main areas: removal of volatile fission products by voloxidation, dissolution of the fuel using nitric acid with and without dissolution promoters, removal of iodine from the fuel solution, and trapping and disposal of this iodine. Significant progress has been made in all these areas during the past six months. Voloxidation was further tested with short-cooled irradiated fuel. A rotary voloxidizer was assembled for use in the hot cell and tested with cold UO_2 fuel. Tests with both irradiated fuel and PuO_2 microspheres have shown that Ce^{4+} promotes the dissolution of PuO_2 in nitric acid. The Ce^{4+}/Ce^{3+} ratio was shown to be an important variable and methods for reoxidizing Ce^{3+} to Ce^{4+} were studied. Results of corrosion tests showed that titanium and tantalum were not attacked by Ce^{4+} in nitric acid. Iodine was successfully removed from a simulated dissolver solution containing uranium and nonradioactive fission products using techniques in which

$H_2O_2-N_2O_3$ and $O_3-N_2O_3$ were utilized. Iodine was also volatilized from a short-cooled irradiated fuel solution. The Iodex process was studied further for removal of both I_2 and CH_3I in a countercurrent bubble-cap column. The kinetics and mechanism of the reaction of I_2 with concentrated nitric acid were studied. In addition, the production of hyperazeotropic nitric acid by the reaction of NO_2 with acid of lower concentration was demonstrated. (auth)

29200 (ORNL-TM-4394) AQUEOUS FUEL REPROCESSING QUARTERLY REPORT FOR PERIOD ENDING SEPTEMBER 30, 1973. Unger, W. E.; Irvine, A. R.; Mailen, J. C.; Watson, C. D. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. W-7405-eng-26. 61p. AT.

Plasma-arc cutting tests which simulate removal of gas plenum sections of fuel assemblies continue to yield encouraging results. Tests with fuel assembly compacting feet (necessary for constraining fuel assembly components during the shearing operation) have yielded apparently satisfactory results with simulated ductile fuel. Other tests are in preparation to determine the effect of reduced ductility in spent fuel assembly materials. A new series of tests using short-cooled fuel was begun. Voloxidation removed 92 to 98% of the $3H_2O$ and 20 to 48% of the ^{85}Kr. A simulated rotary voloxidizer is being designed for use in hot-cell tests. Studies of methods of oxidation of Ce^{3+} to Ce^{4+} were made and electrolytic oxidation appears to be the best method. The presence of 0.3 M boron had no effect on the dissolution of UO_2-PuO_2 pellets in nitric acid. Dissolution tests on short-cooled fuel are examining the physical character and composition of the residue after nitric acid dissolution. Equipment to study the hydrodynamic characteristics of the dissolver has been installed and is being tested. Design studies of the dissolver have considered criticality control, the desirability of liquid downflow through the dissolution tubes to remove fine particles, and the possibility that a rotary vessel dissolver can be used. Iodine was successfully removed from simulated fuel solutions and from short-cooled fuel solutions with DFs of 400 to 600. A new technique for removing iodine which uses H_2O_2 was successfully tested. Continuous iodine stripping using a combined treatment with N_2O_3 and H_2O_2 was successfully demonstrated. A series of experiments with the Iodex flowsheets in a 3-in.-diam bubble-cap (two plates) tower at 25°C and 20 M HNO_3 gave slightly better stage DF than earlier runs in the 1-in.-diam test column. Laboratory work was started to better define the equilibrium and kinetics of the reactions involved in scrubbing iodine forms from air with concentrated nitric acid. Reaction rate constants for the two reactions involved in conversion of I_2 to HIO_3 are presented. (auth)

29201 GASEOUS RADIOACTIVE EMISSIONS FROM REPROCESSING PLANTS AND THEIR POSSIBLE REDUCTION. Beaujean, H.; Bohnenstingl, J.; Laser, M.; Merz, E.; Schnez, H. (Kernforschungsanlage, Juelich, Ger.). pp 63-78 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The most important gaseous and volatile radioactive isotopes emitted from reprocessing plants are ^{3}H, ^{85}Kr, ^{129}I, and ^{131}I. In addition, HTR plants also release ^{14}C resulting from the burning of the graphite matrix of the irradiated fuel elements. To conform to the German policy to limit the dose rate to 30 mrem/yr in the vicinity of nuclear plants, the different gaseous and volatile radioisotopes must be retained to a greater or lesser extent. Decontamination factors of 100 are sufficient for the retention of ^{3}H and ^{85}Kr. For iodine, however, decontamination factors greater than 2000 may be necessary for FBR fuel. Since the separation of ^{14}C from inactive carbon dioxide or a quantitative retention of the burner off-gas is not economically feasible, ^{14}C will be quantitatively emitted. Methods for the decontamination of different types of off-gases are described. The processes under development will be able to fulfil the demand for the retention of ^{3}H and ^{85}Kr. However, further development is necessary to obtain adequate iodine retention. (auth)

29202 ESTIMATION OF RADIATION EXPOSURE ASSOCIATED WITH INERT GAS RADIONUCLIDES DISCHARGED TO THE ENVIRONMENT BY THE NUCLEAR POWER INDUSTRY. Bryant, P. M.; Jones, J. A. (National Radiological Protection Board, Harwell, Eng.). pp 91-107 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

Several fission product isotopes of krypton and xenon are formed during the operation of nuclear power stations, while other radioactive inert gases, notably isotopes of argon and nitrogen, are produced as neutron activation products. With the exception of ^{85}Kr these radionuclides are short-lived, and the containment and hold-up arrangements in different reactor systems influence the composition of the inert gas mixtures discharged to the environment. Cooling of irradiated fuel before chemical reprocessing reduces very substantially the amounts of the short-lived krypton and xenon isotopes available for discharge at reprocessing plants, but almost all the ^{85}Kr formed in the fuel is currently discharged to atmosphere from these plants. Estimates are made of the radiation exposure of the public associated with these discharges to atmosphere taking into account the type of radiation emitted, radioactive half-life and the local, regional and world-wide populations concerned. Such estimates are often based on simple models in which activity is assumed to be distributed in a semi-infinite cloud. The model used in this assessment takes into account the finite cloud near the point of its discharge and its behavior when dispersion in the atmosphere is affected by the presence of buildings. This is particularly important in the case of discharges from those reactors which do not have high stacks. The model also provides in detail for the continued world-wide circulation of the longer-lived ^{85}Kr. (auth)

29203 EMPIRICAL BENEFITS DERIVED FROM AN ECOSYSTEM APPROACH TO ENVIRONMENTAL MONITORING OF A NUCLEAR FUEL REPROCESSING PLANT. Platt, R. B. (Emory Univ., Atlanta, GA); Palms, J. M.; Ragsdale, H. L.; Shure, D. J.; Mayer, P. G.; Mohrbacher, J. A. pp 673-700 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The environmental monitoring program for a nuclear fuel reprocessing plant (Allied-Gulf Nuclear Services) located in the South Carolina coastal plain, is based on a man-environment ecosystem concept. Impact measurement and analysis capabilities include radionuclides, noxious chemicals and heat. The principal pathways to man, atmospheric, terrestrial and aquatic, are each subdivided into natural, recreational and domestic components. Basic inputs include meteorology, geology, surface drainage, direction and velocity of groundwater flow, interaction of underlying aquifers and ecological descriptions of the various interrelated ecosystems of the site and region. Process water is discharged through an ecological monitoring, conditioning and cooling pond. Sampling from a 100 square mile grid is based on significant links in the various ecological pathways. Standardized procedures for sample collection, processing and analysis have been developed. All data may be stored, retrieved and analyzed through an open computerized program, designed so that additions can be made and data verified and retrieved under any ordered scheme for either printed or graphic display. Empirical benefits include a means for merging results of basic research on distribution and fate of radionuclides, noxious chemicals and heat in the natural environment with monitoring activities, based on direct and indirect pathways to man. The use of ecologically defined samples provides rates of movement and bio-accumulation that: are sensitive enough to verify the adequacy of source control with respect to environmental quality; indicate magnitudes and trends of ecological impacts and therefore serve as an early warning system of potential adverse effects to the environment and man before they become irreversible or expensively reversible; and provide a base for comparison with measurements and analyses of effluents from other sources on a regional and international scale. The program can accommodate additional questions and unexpected impacts. The procedures and ecological models are transferable to other nuclear industry. Thus, through the characteristics of comparability, accommodation, predictability, and transference, the program emphasizes those basic factors and procedures that are necessary for determining the capacity of the environment to recieve radionuclides, with emphasis on both natural and human radiation exposures. (auth)

29204 REPROCESSING IN EUROPE TODAY. Zuehlke, P. (United Reprocessors GmbH, Karlsruhe, Ger.). Reprocess. Newslett.; No. 1, 4-7(1973).

The need for a combined application in Europe of the developed processes for reprocessing, as well as for an economical operation of the plant for industry and electricity works, led to the coordination of the reprocessing interests of Great Britain, France and Germany under the name of United Reprocessors. (orig./LH) (GE)

29205 REPROCESSING IN EUROPE TODAY. Zuehlke, P. (United Reprocessors GmbH, Karlsruhe, Ger.). At. Jap.; 17: No. 6, Suppl., 9-16(Jun 1973).

From sixth annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

Reprocessing of irradiated fuel and the ancillary services of transport and finishing have been organized to serve the nuclear power industry within Europe around United Reprocessors. It was formed in October 1971 between the major nuclear countries, France, Germany and the United Kingdom to coordinate R & D with plant design and construction and supporting services in reprocessing and to market the services of the plants belonging to the shareholders. United Reprocessors are closely connected with world-wide transport organizations in the supporting services to reprocessing. Starting with the British in 1949 some reprocessing plants came into operation in Europe one after another, although, the economic penalties of under utilization are heavy, and the size and timing of a new plant must be matched against the curve of increase in available fuel so that the plant is full as soon as possible. In discussing future reprocessing costs estimating the overall capital costs, expressed in 1972 dollars, $45M for a 300 t/y plant and $85M for a 1500 t/y plant, total reprocessing costs for 1 t/d plant will be $88/kg and $33/kg for a 5 t/d plant, if a plant life of 15 years is assumed. At $6/g fissile the value of PWR fuel is $70.2 and BWR $49.8. Apart from fuels from magnox type reactors the total reprocessing demand in Europe is expected to increase from 100 t/y in 1972, to about 1400 t/y in 1980 and 4000 t/y by 1985, then an optimum size plant of about 1500 t/y will be required. (JA)

29206 BARNWELL, THE FIRST FULL-SIZED FACILITY DESIGNED SPECIFICALLY FOR REPROCESSING OF LWR FUEL. Osborn, K. R. (Allied Chemical Corp., Idaho Falls, Idaho). At. Jap.; 17: No. 6, Suppl., 49-55(Jun 1973).

From sixth annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

The Barnwell Nuclear Fuel Plant is the first full-sized reprocessing plant designed to handle light-water reactor fuel, having a capacity of 1500 MTU/year and annual average power of 40 MW(t)/MTU, and is now under construction and anticipated to start commercial operation in 1975. Water used for cooling purposes is cooled by primary cooling water through heat exchanger to assure against thermal pollution. Peak summer water discharge will not exceed 85°F. To assure full ecological compatibility of the discharged water with the receiving stream, a conditioning pond having water volume capacity of over two weeks running, and a pine forest being irrigated by spraying with said water of pond are provided. There are two cleanup systems for airborne releases consisting of the off-gas system and the building ventilation system; the former includes recovery system for nitrogen oxides and filters, scrubbers and adsorbers for removal of particles, iodine, and other volatile radionuclides, and the latter uses three HEPA filters in series to filter air at the cell with high efficiency filtration. The liquid wastes will be stored for a period of up to five years, then converted to a solid form suitable for ultimate disposal by a process on which the technology is generally known and proven. It is of course necessary to check all portions of the plant with the monitoring system. (JA)

29207 FUEL REPROCESSING. A General Electric View. Levy, S. (General Electric Co., San Jose, CA). At. Jap.; 17: No. 6 Suppl., 30-48(Jun 1973).

From sixth annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

The design of reprocessing plant should satisfy key requirements of safety, minimum environmental impact, and operability, as the indispensable matters. The MFRP (Midwest Fuel Recovery Plant) uses a single cycle of solvent extraction to separate more than 99.9% of fission product radioactivity in an aqueous waste stream of moderate volume. Pu and Np are recovered by ion exchange for concentration and load-out in nitrate solution form. U is processed through denitration, fluorination and clean-up processes which remove contaminants and produce the UF_6 product without generating additional liquid waste. There is no process liquid waste or cooling water discharged to the environment. Waste vaults and basins at MFRP are constructed of reinforced concrete set in bedrock, and equipped with stainless steel liners. Ventilation systems employ pressure, and all differential control, with personnel areas above atmospheric pressure, and all contaminated areas at less than atmospheric pressure (but above off-gas vent pressures in the cell areas). Emergency and safety-related systems are protected against wind, missile, and seismic forces. Owing to severe requirements for shielding, cooling, ease of handling and contamination control as well as safety criteria such as capability to withstand extreme accident conditions, it is concluded that GE has selected the IF 300 Cask principally intended for rail or barge shipment but capable of movement by overweight truck. Detailed IF 300 Cask description is disclosed. (JA)

29208 APPLICATION OF EUROPEAN TECHNOLOGY TO A FUTURE REPROCESSING PLANT. Clelland, D. W. (British Nuclear Fuels Ltd., Risley, Eng.). At. Jap.; 17: No. 6, Suppl., 17-29(Jun 1973).

From 6th annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

A design of a future reprocessing plant based on advanced European technology is outlined stressing the necessity of the achievement of very high standards of environmental protection. The lowest limits in the USAEC regulations 10 CFR part 50 for light water reactors have to be met also for reprocessing plants. A plant based on solvent extraction may satisfy main criteria such as environmental protection and safety, ease of operation, reliability and economy. Salt-free processes will be preferred, in order to minimize waste generation. General specifications for a future reprocessing plant proposed are: Capacity: 1500 t/y of irradiated fuel, Fuel: Uranium oxide fuel canned in zircaloy, Products: Purified uranium nitrate solution (can be converted to UO_3 and/or UF_6) and plutonium nitrate (to PuO_2), Process: Spent fuel receiving and unloading, cooling of spent fuel, chopping and leaching, purification and separation by solvent extraction, product concentration and storage, nitric acid recovery, waste management, analytical services, site services. Proposed techniques and methods concerning to the processes above are provided with comments and consideration. Concerning high level waste, vitrification is now considered to be the safest method. The containers of vitrified waste will be stored under water and after sufficient decay in specially engineered concrete vaults. Present status of European research and development in reprocessing is also introduced with highlights of new techniques already available or under development. (JA)

29209 DEMAND AND SUPPLY OUTLOOK ON FUEL REPROCESSING IN JAPAN. Tanaka, N. (Tokyo Electric Power Co. Inc.). At. Jap.; 17: No. 6, Suppl., 3-8(Jun 1973).

From 6th annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

The annual demand for reprocessing in Japan is expected to be approximately 500 tons of uranium by 1980 and will increase to 2000-2800 tons by 1990. The all-over annual demand for reprocessing in the free world, including Japan, will be 6000 tons of uranium by 1980. For reprocessing, PNC is now building No. 1 facility at Tokai, Ibaraki Prefecture. The commercial operation is scheduled for January 1975. The capacity of No. 1 facility is for 0.7 ton of uranium a day and 210 tons of uranium a year. Facility No. 1 is expected to reach its limit by the year 1978. The operation of No. 2 facility must begin from this date. Assuming No. 2 facility has a daily capacity of 3 tons of uranium, it would be possible to meet the total reprocessing demand in Japan for the period of 4 years ending in 1985. Taking the capacity at 5 tons a day, it would be possible to meet the demand for 6 years, up to 1988 a period to 8 years is considered necessary from first planning to start-up. This facility will mainly meet domestic demand, the scale of the facility should be determined by domestic economic factors and the calculation of domestic cost covering siting, transportation, etc. The procurement of a site is a strong factor governing the period of construction. The Government should take active measures to promote the environmental development of any siting area and its vicinity in order to meet the situation. There is some possibility of finding a more profitable form of business structure by joint promotion of the project with foreign cooperation. On the other hand, additional consideration would have to be given to the following points, the economic factors involving long distance transportation, the siting and the types of regulations imposed and also the method for treatment and disposal of waste. (JA)

29210 OPERATIONAL HEALTH PHYSICS PROBLEMS IN THE EBR-II FUEL CYCLE FACILITY. Cook, E. M.; Graham, E. D.; Stoddard, P. G.; Lee, F. W. (Argonne National Lab., Idaho Fall, ID). pp 125-140 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The EBR-II Fuel Cycle Facility is described and the fuel reprocessing operation is discussed. Health physics procedures for repair of in-cell equipment include estimates of surface radiation levels, use of respirators and protective clothing, construction of repair area for electromechanical manipulators, use of dust mops sprayed with floor cleaning oil for decontamination, and lead shielding. Personnel exposures were caused by direct beta-gamma radiation from the fuel in the air cell during the removal and replacement. Exposure due to beta-gamma radiation from the fission-product contamination of the electromechani-

cal manipulators was received during all operations. Permanent decontamination and repair facilities for in-cell equipment were constructed and these facilities provide remote, shielded decontamination of the equipment by a high-pressure water-detergent mixture and by steam. (HLW)

29211 SEPARATION PROCESSES FOR RARE GAS FISSION PRODUCTS FROM THE OFF-GAS OF NUCLEAR FACILITIES. Yamamoto, Y. (Tokyo Univ.). Nippon Genshiryoku Gakkaishi; 15: No. 4, 211-219(Apr 1973). (In Japanese).

With the advance of atomic energy utilization, the problem of radiation exposure and its effect is attracting world-wide interest. It is necessary to control release of radioactive gases from nuclear power plants and fuel reprocessing plants into the atmosphere. Of rare gases from the nuclear power plants, ^{85}Kr is the most important because of its long half-life. It becomes more significant in the case of fuel reprocessing plants due to the large quantity of ^{85}Kr. The release of radioxenon with short half-life becomes important in the reprocessing of fast-reactor fuel. Removal of the radioactive rare gases including krypton and xenon, because of their chemical stability, must depend on physical means. The following four methods currently available are described: adsorption, liquefaction and evaporation, absorption, and separation with membrane. In the future, studies of the respective methods including economic aspect are necessary. (JA)

ENGINEERING

Energy Conversion

Refer also to abstracts 29250, 29562–29565, and 29981.

29212 (JPRS-61637) HIGHLY EFFICIENT SUPERSONIC NONEQUILIBRIUM MHD GENERATOR. Belykh, A. D.; Gurashvili, V. A.; Golubev, V. S. Translated from Teplofiz. Vys. Temp.; 11: No. 6, 1289-1291(1973). 4p. NTIS.

The results of an experiment to prove the feasibility of effective MHD-deceleration of plasma with nonequilibrium conductivity and high output power (~10^6 W) are presented. (auth)

29213 (ORNL-TM-4422) TEST OF FUSIBLE INSULATION FOR A PROPOSED ISOTOPE POWER UNIT. Lackey, M. E. (Oak Ridge National Lab., Tenn. (USA)). Apr 1974. Contract W-7405-eng-26. 86p. Dep. NTIS $7.50.

In support of the Isotope Kilowatt Program, an evaluation test of the full-scale simulated thermoelectric power generation system was made. The test was run with 6.5 in. of fusible insulation around the heat block-shield to determine the system heat losses. A loss of 10% of full power was obtained with the system operation at a heat block-shield surface temperature of 1100°F and an argon pressure of 1.0 psig. A test was run to determine the thermal coupling between the heat block-shield and 12 heat pipes with 12 simulated thermoelectric generators. A heat pipe condenser temperature of 1040°F was obtained at a heat block-shield surface temperature of 1150°F at a total power input of 34 kW. A loss-of-coolant accident test was made to determine the maximum fuel capsule surface temperature reached during a meltdown of the fusible insulation. The meltdown results yielded a maximum fuel capsule surface temperature of 2175°F and an equilibrium temperature of 2070°F. (auth)

29214 (SLA-74-80) ANALYSIS OF FAST RISETIME PULSED THERMOELECTRIC GENERATOR. Burgess, E. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1974. Contract AT(29-1)-789. 28p. Dep. NTIS $4.50.

A pulsed thermoelectric generator which is heated by fissioning of ^{235}U when exposed to a pulse of neutron irradiation is discussed. The open circuit voltage response of the device is determined using the CINDA numerical differencing analyzer computer code. A parametric study of material properties affecting system response is performed. (auth)

29215 (SLA-74-111) DEVELOPMENT OF AN INTERCONNECTION METHOD FOR THE RTG (RADIOISOTOPE THERMOELECTRIC GENERATOR) OUTPUT CIRCUIT. Johnson, D. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1974. Contract AT(29-1)-789. 34p. Dep. NTIS $4.75.

The results of development studies leading to an interconnection method for the output circuit are described. Procedures recommended include the use of thick film platinum-gold metallization in conjunction with parallel gap welding of the ribbon-to-circuit and ribbon-to-side contact joints. Variables investigated include the type and thickness of thick film, and the weld parameters such as voltage, time, electrode force, and electrode gap. Techniques proven in development are summarized in the form of process descriptions. Satisfactory metallization and bond parameters were developed and the system appears suitable for production application. (auth)

29216 THERMOELECTRIC CONVERSION RADIOISOTOPIC GENERATOR FOR USE IN OFF-SHORE OIL FACILITIES. Germano, G.; Merzagora, N. Com. Naz. Energ. Nucl., Notiz.; 19: No. 12, 77-86(Dec 1973). (In Italian).

It is well known that in the near future there will be a large availability of radioisotopes derived from reprocessed fissile fuel as a result of the increasing number of nuclear power reactors. The potential industrial uses of such isotopes, as power sources for long-lived electric power generators in inaccessible sites, and the growing interest in the exploitation of undersea oil reserves have led to the development of a thermoelectric generator for underwater applications down to a depth of 200 meters. An analysis of the most suitable radioisotope sources for these applications is presented; the thermal and electrical power balance for a thermoelectric generator is discussed; and a specific design for a 5W(e) prototype, fueled by 20,000 Ci of ^{90}Sr, with a 5 y life, is finally described. The generator, presently in an advanced stage of construction is being developed as a power source for instrumentation and automated equipment for a subsea wellhead. (auth)

29217 THERMOELECTRIC GENERATOR. Pryslak, N. E. (to United States Atomic Energy Commission). US Patent 3,794,526. 26 Feb 1974. Filed Date 21 Apr 1967. 6p.

A thermoelectric generator having a rigid coupling or "stack" between the heat source and the hot strap joining the thermoelements is described. The stack includes a member of an insulating material, such as ceramic, for electrically isolating the thermoelements from the heat source, and a pair of members of a ductile material, such as gold, one each on each side of the insulating member, to absorb thermal differential expansion stresses in the stack. (Official Gazette)

29218 THERMOELECTRIC CONVERTER. Kim, C. K. (to United States Atomic Energy Commission). US Patent 3,794,527. 26 Feb 1974. Filed Date 15 Jan 1970. 4p.

This invention relates in general to thermoelectric units and more particularly to a tubular thermoelectric unit which includes an array of tandemly arranged radially tapered annular thermoelectric pellets having insulation material of a lower density than the thermoelectric pellets positioned between each pellet. (Official Gazette)

29219 RELIABLE, INDEPENDENTLY OPERATING, AND COMPACT RADIOISOTOPE POWER GENERATORS. Catier, E. Electron. Microelectron. Ind.; No. 178, 75-83(15 Oct 1973). (In French).

Radioisotope-fueled source electrical generators having long lifetimes (several years) and a high degree of reliability are rapidly being developed for medical applications, e.g., ^{238}Pu cardiac pacemakers. The independence of operation of such devices leads to applications in the fields of telecommunications, the providing of ground-markers in desert regions, underwater technology, oceanography and oil exploration. (FR)

Facilities and Equipment

Refer also to abstract 29613.

29220 (AECL-4585) CONVERSION TO SI UNITS OF SOME PORTIONS OF THE ASME PRESSURE VESSEL AND BOILER CODE, SECTION III (1971 EDITION). Head, D. A.; Christie, D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Dec 1973. 83p. Dep. NTIS (U.S. Sales Only) $7.25. AECL $2.00.

A "rationalized" soft conversion to SI units of the Stress Tables and miscellaneous graphs and tables from the 1971 edition of the ASME Pressure Vessel and Boiler Code, Section III is presented. Relevant sections of the addenda dated Winter 1971, Summer 1971, Winter 1972, and Summer 1972 have also been incorporated in this conversion. (auth)

29221 (COO-1248-33) ELECTRICAL CHARGING OF SMALL PARTICLES AT LOW PRESSURES. Tenth Progress Report. Particle Technology Laboratory Publication No. 193. Liu, B. Y. H.; Whitby, K. T. (Minnesota Univ., Minneapolis (USA). Particle Technology Lab.). Nov 1972. Contract AT(11-1)-1248. 24p. Dep. NTIS $4.50.

Results of performance tests on several ^{85}Kr aerosol charge neutralizers are reported. (TFD)

29222 (TID-26487, pp 125-133) EXPERIENCES ACQUIRED FROM THE DAMAGE TO THE REHEATER IN THE 50 MW TEST FACILITY AT HENGELO, HOLLAND. de Blieck, T. (Neratoom N. V., The Hague). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

To gain experience in the operation of bigger advanced components for sodium-cooled fast breeder reactors, a 50 MW test facility was built at Hengelo, Holland. The components to be tested are intermediate heat exchangers, steam generators and smaller sodium equipment. The test facility is a natural gas fired loop, containing one pump, an intermediate heat exchanger and steam generator is attached to a turbine simulator. The components to be tested and now in operation are an intermediate heat exchanger and a steam generator, both of the once-through counter-flow type. The steam generator consists of 3 separate units, an evaporator, a superheater and a reheater. The reheater is not considered for the SNR-300. (auth)

29223 LINEAR ANALYTICAL ONE-DIMENSIONAL MODEL DESCRIBING THE FREQUENCY RESPONSE BEHAVIOR OF

SHELL-AND-TUBE TYPE COUNTERFLOW HEAT EXCHANGERS WITH RESPECT TO PRIMARY AND SECONDARY INLET TEMPERATURE AND MASS FLOW PERTURBATIONS. Hoeld, A. (Technische Univ., Munich). Nucl. Eng. Des.; 26: No. 2, 231-241(1974).

A linear analytical one-dimensional model is presented. It is used to calculate the frequency response behavior of coolant temperature and/or coolant mass flow on both (primary and secondary) outlet sides of a counterflow shell-and-tube type heat exchanger with respect to perturbations in the corresponding temperature and mass flow parameters at the inlet to the primary and/or secondary side, respectively. To make the heat exchanger model as comprehensive as possible, mass-flow dependent heat transfer coefficients, an exact solution of the heat conduction through the tube walls, and (at least with respect to the coolant mass flow rates) temperature-dependent coolant densities have been taken into account. The resulting digital code TUMHEX has been tested against frequency response measurements on an industrial-size heat exchanger and has shown good results. (auth)

29224 BUCKLING OF A STUD-SUPPORTED THIN CYLINDRICAL LINER SHELL ENCASED IN CONCRETE. Kicher, T. P. (Case Western Reserve Univ., Cleveland). Nucl. Eng. Des.; 26: No. 2, 250-262(1974).

The problem of a point-supported liner shell encased in a rigid cylindrical cavity is studied. The large displacement equations are developed, and the resulting non-linear equations are solved in closed form for an assumed buckling wave. The analytical model is specialized to the case of the ring or infinite cylinder under circumferential strain, and is compared to published results. Complete load displacement curves are presented for the ring or cylinder with a predominate circumferential strain, and for the axisymmetric response or cylindrical shells under an axial load. The results of this study can be used to determine the spacings of point supports for cylindrical liner shells. (auth)

29225 SOME EXPERIMENTS ON THE DYNAMIC PLASTIC BEHAVIOR OF SHELL INTERSECTIONS. Summers, A. B.; Jones, N. (Massachusetts Inst. of Tech., Cambridge). Nucl. Eng. Des.; 26: No. 2, 274-281(1974).

An experimental investigation into the dynamic plastic behavior of some metal shell intersections is reported. The models consist of a cylindrical nozzle intersecting a hemispherical shell which is subjected to a uniformly distributed internal impulsive velocity field. The magnitude of the initial kinetic energy of the dynamic load is sufficient to cause inelastic behavior and small permanent displacements. (auth)

29226 FINITE ELEMENTS FOR THREE-DIMENSIONAL ELASTIC CRACK ANALYSIS. Tracey, D. M. (Combustion Engineering, Inc., Windsor, CT). Nucl. Eng. Des.; 26: No. 2, 282-290(1974).

An elastic three-dimensional finite element which allows the mode I–mode II inverse square root crack front singularity is described. A three-dimensional solution for the compact tension fracture specimen resulting from use of the element is given. The variation of the stress intensity factor along the crack front is discussed along with the general features of the stress variation from the front. The computer programming of the formulation is discussed and a FORTRAN listing of it is described. (auth)

29227 COMPARATIVE STUDY OF VARIABLE AND CONSTANT THICKNESS HIGH PRECISION TRIANGULAR PLATE BENDING ELEMENTS IN THE ANALYSIS OF VARIABLE THICKNESS PLATES. Venkateswara Rao, G.; Raju, I. S. (Space Science and Tech. Centre, Trivandrum, India). Nucl. Eng. Des.; 26: No. 2, 299-304(1974).

For the analysis of plate bending and vibration problems high precision triangular elements are very attractive. The effect of thickness variation can be included in these elements very easily at the expense of the computer time, for analysing variable thickness plates. On the other hand, variable thickness plates can be analysed as stepped plates with constant thickness elements with less computer time. A comparative study of the use of variable thickness and constant thickness elements for analysing variable thickness plates is attempted by solving three typical problems. The results show that for static problems there is a marginal accuracy when using variable thickness elements as against average thickness elements. However, for vibration problems even though there is not much difference in the fundamental frequency parameter obtained by using both elements, the higher modes obtained by using variable thickness elements are very accurate. (auth)

29228 EFFECTS OF SHEAR AND NORMAL DEFORMATIONS IN CIRCULAR CYLINDRICAL CONTAINERS LOADED AXISSYMMETRICALLY. Korman, T. (Purdue Univ., Lafayette, IN). Nucl. Eng. Des.; 26: No. 2, 309-312(1974).

The effects of shear and normal deformations on an axisymmetrically-loaded circular container are investigated using the mathematical exact theory developed by Zerna. A container which is built-in at both ends and subjected to uniform pressure is analyzed by the mathematical exact theory and the classical shell theory. The magnitudes of the moments at the built-in ends are compared for the cases $t/R = 1/5, 1/10$. (auth)

29229 CREEP DEFORMATION OF A THIN TUBE UNDER COMBINED LOADING. MacDonald, D. Q. (Bell Coll. of Tech., Hamilton, Scotland); Spence, J. Nucl. Eng. Des.; 26: No. 2, 305-308(1974).

Approximate analyses are briefly described for the creep curvature of a thin constant thickness, circular cross-section cylindrical shell under various loadings. The loads are bending moment, internal pressure, and torsion, which may be applied in any combination. It is shown that the results have a certain common feature which allows their presentation in a rather simple but useful form. (auth)

29230 EXPERIMENTAL STUDY ON THERMAL-STRESS RATCHETTING OF AUSTENITIC STAINLESS STEEL BY A THREE BARS SPECIMEN. Uga, T. (Japan Atomic Energy Research Inst., Tokai). Nucl. Eng. Des.; 26: No. 2, 326-335 (1974).

A new test specimen for thermal-stress ratchetting is proposed and tested for standard AISI-304 stainless steel. Its purpose is to avoid the drawbacks of a tubular specimen. It is a special plate-shaped specimen with two symmetrical, straight air gaps in the center portion and load chucks at the ends. Since three surfaces out of four on the side bars are enveloped by sheathed trace heaters, the middle bar becomes a cold element and the rest side bars hot elements during thermal loading. Experiments on thermal-stress ratchetting are performed with this specimen. Interesting incremental strain growth behavior of the specimen subjected to cyclic thermal stresses under a steady primary load is obtained with regard to an actual strain-hardening material. It was confirmed that incremental strain growth decreased with increase in the cumulative strain growth. There is expected to be an asymptotic cumulative strain growth for any test condition. It is also found that the tendency for theoretical strain growth is fairly similar to that found experimentally. However, the experimental data are considerably greater than the theoretical data. This can be explained qualitatively by a decrease in both yield strength and Young's modulus at high temperature for the hot elements. (auth)

29231 IMPROVEMENTS TO TUBULAR HEAT EXCHANGERS. (to Societe Babcock-Atlantique). French Patent 2,162,251. 7 Dec 1971. 11p. (In French).

A heat exchanger possessing an array of tubes is presented. Each of these tubes is subjected to a force which is distributed along its length. A special feature of the system is that the different pressures are systematically offset in an alternate manner on both sides of the primitive axis of the tube. In this way a prestressed state generating elastic reactions at the tube-pressure interface is obtained by bending or torsion. (FR)

29232 CONDUCTION PUMP FOR LIQUID METALS. Ertaud, A.; Parossian, J.; Carbonnel, H. (to Groupement Atomique Alsacienne Atlantique). French Patent 2,164,493. 22 Dec 1971. 7p. (In French).

A conduction pump for liquid metals is described. This pump, which can be immersed in the metal, is provided with a tube within which the metal circulates and a spiral which is in the form of a refractory envelope containing the liquid metal. A special feature of the system is that the envelope is connected to the tube by two end parts each of which is provided with at least one opening communicating the inside of the envelope with the inside of the tube. (FR)

29233 COMPACT LASER AMPLIFIER SYSTEM Carr, R. B. (to United States Atomic Energy Commission). US Patent 3,794,929. 26 Feb 1974. Filed Date 13 Oct 1972. 4p.

A compact laser amplifier system is described in which a plurality of face-pumped annular disks, aligned along a common axis, independently radially amplify a stimulating light pulse. Partially reflective or lasing means, coaxially positioned at the center of each annualar disk, radially deflects a stimulating light directed down the common axis uniformly into each disk for amplification, such that the light is amplified by the disks in a parallel manner. Circumferential reflecting means coaxially disposed around each disk directs amplified light emission, either toward a common point or in a common direction. (Official Gazette)

29234 INDUSTRIAL EXPERIENCE OF VIBRATION PROBLEMS IN THERMAL EQUIPMENT. Coursimault, J. (Societe Babcock-Atlantique, Paris). pp 365-379 of Recherches Actuelles et Applications Industrielles. Paris; Eyrolles (1973). (In French).

From fluid mechanics summer school; Ermenonville, France (4 Sep 1972).

A number of cases of vibrations developed by flow in exchangers and industrial circuits are reviewed. The improvements made are presented together with the developments necessary to master such phenomena. (FR)

29235 STUDIES OF A PORRO-PRISM Q-SWITCHED Nd^{3+}-GLASS GIANT-PULSE LASER OSCILLATOR. Hill, K. O. (Communications Research Centre, Ottawa); Campbell, C. K. Can. J. Phys.; 51: No. 1, 20-24(1 Jan 1973).

Heat Transfer and Fluid Flow

Refer also to abstracts 29223, 29231, 29234, 31133, 31168, 31176, 31199, 31200, 31211, 31212, 31237, 31356, 31376, 31391, 31404, and 31542.

29236 (AERE-R-7338) INFRA-RED BURN-OUT DETECTOR. Benn, D. N.; Shock, R. A. W. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Feb 1974. 10p. Dep. NTIS (U. S. Sales Only) $4.00. UK 50 pence.

An infrared burnout detector intended as a safety device for heat transfer experiments is described. Use has been made of a commercial infrared pyrometer and a purpose-built voltage level detector and trip circuit. Details of the electronic circuit, the time response and sensitivity are given. (auth)

29237 (CONF-730465-, pp vp. V. 4, Paper 411) PRESSURE DISTRIBUTIONS ON IN-LINE TUBE ARRAYS IN CROSS FLOW. Batham, J. P. (Central Electricity Research Labs., Leatherhead, Eng.). [nd]

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Measurements were made of mean and fluctuating pressures on tubes in in-line square arrays having pitch/diameter ratios of 2:1 and 1.25:1. Tests were performed at Reynolds numbers between 2.8×10^4 and 10^5, and it was found that Reynolds number had a negligible effect on mean and fluctuating pressure coefficients within this range. Incident turbulence had a large effect on the excitation on the widely pitched array, but no effect on the closely pitched array. The flow through the closely pitched array was found to be highly three-dimensional. The mean pressure distribution on a tube was highly sensitive to movements of order 5×10^{-3} tube diameters of the upstream tubes. A Coanda mechanism is suggested; it could give rise to large fluctuating forces in practical boilers. (auth)

29238 (CONF-730465-, pp vp. V. 4, Paper 412) STATIONARY AND INSTATIONARY FLOW PHENOMENA IN AND BEHIND STAGGERED AND IN-LINE TUBE BANKS. Heinecke, E. (Kernforschungsanlage, Juelich, Ger.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Investigations on the flow scheme in staggered and in-line tube banks are described. For staggered arrays the work has been concentrated on unsteady flow fluctuations. Different measuring techniques have shown that the fluctuations are of narrow band character. It is therefore possible to give a dimensionless description of the unsteady flow by the Strouhal-number. If the geometrical array, velocity of sound and the shape of the heat exchanger containment are given it can be calculated if excitation of standing acoustical waves is expected. Investigations of in-line arrangements show that the flow may either be of narrow band or of broad band character, depending on the longitudinal pitch of the tube bank. In the first case the definition of a Strouhal-number is no longer possible and it is difficult to predict if acoustical or mechanical resonance effects will occur. In-line arrays with statistical flow fluctuations generate uneven velocity profiles behind the last row whereas arrays with narrow band fluctuations do not show this tendency. The experiments cover a range of Reynolds-number 10^4 to 10^5. (auth)

29239 (CONF-730465-, pp vp. V. 4, Paper 424, Pt. 1) EXPERIMENTAL STUDIES ON FLOW INDUCED VIBRATION TO SUPPORT STEAM GENERATOR DESIGN. Part I. Vibration of a Heated Cylinder in Two-Phase Axial Flow. Pettigrew, M. J. (Chalk River Nuclear Labs., Ont.); Gorman, D. J. [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

An exploratory vibration experiment on a heated cylinder in axial flow was conducted in a steam/water test loop. Vibration measurements were taken under various flow conditions while steam was either added at the inlet of the test section or generated by the heated cylinder. The contributions of subcooled and bulk nucleate boiling noise to vibration amplitude were investigated. The effects of other flow parameters such as pressure, mass flux and steam quality were also studied. The results show that the vibration response appears highly dependent on flow regime. Nucleate boiling noise did not cause excessive vibrations in this experiment. (auth)

29240 (CONF-730465-, pp vp. V. 5, Paper 517) ATTENUATION OF THE UNSTEADY FLOW STATE OF THE DIRECTLY IMPINGING CO-AXIAL ANNULAR FLOWS. Horne, J. L. (Queen's Univ., Belfast). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

An investigation into the flow behavior of two directly impinging co-axial annular flows has shown that two states of flow can exist. The results of an investigation to find out if changes in the geometry of the flow boundaries could attenuate, or even eliminate the unsteady flow condition are given. A slotted wall configuration was developed which effectively did this. (auth)

29241 (CONF-730465-, pp vp. V. 5, Paper 522) EXPERIMENTAL INVESTIGATION OF AN ANALYTICAL MODEL FOR PARALLEL FLOW INDUCED VIBRATIONS OF ROD STRUCTURES. Ohlmer, E. (Joint Nuclear Research Center, Ispra, Italy). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

An analytical model describing the parallel flow induced vibrations of rod structures was investigated experimentally. Experiments were performed both in a single rod and a three rod arrangement using water flow. In each case the pressure difference fluctuations on the rod surface as the acting driving forces and also the resulting rod vibration displacements were measured on the same instrumented rod. The single rod test confirms the validity of the analytical model. The rod bundle test, in addition to revealing some difficulties which may be encountered in practice with complex structures, yielded some interesting properties of the pressure fluctuation field in such a geometry and shows the influence of geometric parameters. (auth)

29242 (FPR-1-74) Al/WATER SHOCK TUBE EXPERIMENTS AT AWRE, FOULNESS SINCE JANUARY 1972. Guest, J. N.; Turner, R. G.; Rees, N. J. M. (UKAEA Weapons Group, Foulness. Atomic Weapons Research Establishment). Jan 1974. 21p. (CONF-731126-2; TRG-Memo-6415; CFR-SWP/P-(74)1). Dep. NTIS (U. S. Sales Only) $3.25.

From second specialist meeting on sodium fuel interaction in fast reactors; Ispra-Varese, Italy (21 Nov 1973).

Work on this rig up to April 1971 was reported to the last Crest meeting in January 1972. An inspection of the shock tube had revealed damaged gauge seatings and a more robust replacement tube has now been supplied, complete with high quality vacuum ball valves in place of the simple gas cocks used previously. The driving reservoir is now a sealed integral extension of the top of the shock tube with the same internal bore. This enables a direct measure of the mechanical work transferred to the water column to be made by measuring the peak pressure in the recompressed reservoir gas. The improved containment has increased the measured transient peak water pressure in the thermal interaction by 25% as compared with directly comparable figures reported in January 1972. A program of parameter variation is now proceeding in this all metal rig, starting with the temperature of the molten aluminium. The pressurized viewing cell proposed in 1972 has been designed and will be constructed and brought into use by Spring 1974. (auth)

29243 (ORO-3936-11) VAPOR EXPLOSION: HEAT TRANSFER AND FRAGMENTATION. VII. Molten-Metal/Water Interactions Prior to a Vapor Explosion. Hsiao, K. H.; Cox, J. E.; Witte, L. C. (Houston Univ., Tex. (USA). Dept. of Mechanical Engineering). Jan 1974. Contract AT(40-1)-3936. 176p. Dep. NTIS $12.00.

When a hot molten material comes into contact with a cool liquid, a violent explosion may occur. Based on prior laboratory observations of molten-metal/water interactions, fragmentation of the molten material is a necessary ingredient for the occurrence of an explosive incident. An analytical model is developed to describe the sequence of events associated with a hot molten sphere falling into a cool liquid, when a vapor blanket instantaneously surrounds the sphere. Energy and momentum considerations for each of the coupled regions (the molten-metal sphere, the vapor shell and the surrounding liquid coolant) provide the transient growth of the vapor-film thickness and the temperature distribution in the liquid coolant. When the vapor film collapses, the molten-metal/liquid-

coolant contact is initially a point rather than the entire vapor shell collapsing instantaneously. When the vapor film collapses locally, the liquid coolant is described by a semi-infinite model. The resulting limit-of-superheat temperature determination shows that the proposed limit-of-superheat explanation for the vapor explosion is inappropriate. Based on the predictions of the model, the mechanism of fragmentation of the molten material appears to result from cavitation following the rapid cooling associated with collapse of the vapor film. (auth)

29244 (RD/B/N-2827) FLOW CALIBRATION UNIT FOR USE IN HEAT TRANSFER RIGS. Stephens, M. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1973. 32p. Dep. NTIS (U. S. Sales Only) $4.75.

A flow calibration unit has been designed and manufactured to enable calibration of most of the experimental rigs used by the heat transfer section. Brief details are given of the unit, its calibration at Hams Hall Hydraulic Calibration Center, and the equations and calculation procedure necessary to analyze results from calibration experiments. (auth)

29245 (SLA-74-5230) RADIAL AND CIRCUMFERENTIAL EQUILIBRATION OF A RADIANT ENERGY PULSE IN A CYLINDRICAL COMPOSITE. Schimmel, W. P. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 11p. (CONF-731106-5). Dep. NTIS $4.00.

From 13th international conference on thermal conductivity; Lake Ozark, Missouri, USA (5 Nov 1973).

An analytical solution was obtained for the transient temperature distribution in a multi-layered medium consisting of several concentric right-circular cylinders. Since the solution is "exact" in the mathematical sense, it is free from some of the shortcomings of numerical techniques. For example, having once determined the radial and circumferential eigenvalues for a particular problem, it is possible to evaluate the temperature at a particular position in the composite and at a particular time without solving for the temperature field at all previous times. (auth)

29246 (SRARI-P-200) STABILITY AND MONOTONY RANGES FOR TWO-POINT DIFFERENCE SCHEMES OF THERMAL MASS TRANSFER EQUATION. Antipin, G. K. (Nauchno-Issledovatel'skij Inst. Atomnykh Reactorov, Dimitrovgrad (USSR)). 1972. 28p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.50.

Stability and monotony ranges were studied for two-point difference schemes of a thermal mass transfer equation with coefficients depending on a space coordinate. (auth)

29247 (WAPD-TM-1133) DIRECT ITERATION METHOD FOR THE INCORPORATION OF PHASE CHANGE IN FINITE ELEMENT HEAT CONDUCTION PROGRAMS. Friedman, E. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Mar 1974. Contract AT(36-1)-GEN-14. 27p. Dep. NTIS $4.50.

A direct numerical iteration procedure to account for latent heat absorbed or liberated as a result of phase transformation in transient heat conduction problems is described. The application of this method to finite element heat conduction programs is then outlined. Results of sample problems are presented for comparison of this iterative technique with a commonly-used noniterative solution procedure. (auth)

29248 DUAL PHOTON SOURCE METHOD FOR VOID FRACTION MEASUREMENTS IN DYNAMIC FLUID SYSTEMS. LeVert, F. E. (Tuskegee Inst., AL). Nucl. Eng. Des.; 26: No. 2, 336-339 (1974).

A dual source method of void fraction measurements in flowing media is described. The method is compared with the commonly used single source as a means of making measurements of dynamic fluid systems. The dual source method is shown to be less severe when the static void assumption is made. Also, it is shown that the mean void fraction determined by this method is independent of the thickness of flowing fluid. Both the single and the dual source methods are compared for an assumed case of Poisson-distributed voids passing the detector location. (auth)

29249 HIGH SPEED TWO-PHASE FLOW. 2. Flashing Flow Through A Converging–Diverging Nozzle. Adachi, H.; Yamamoto, N. (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 15: No. 12, 847-855(Dec 1973). (In Japanese).

A series of two-phase flashing-flow experiments with a converging-diverging nozzle was performed. The throat diameter of the test nozzle was 10 mm, and the nozzle length 200 mm. The maximum pressure of the reservoir was 30 kg/cm^{2}G, and the quality of the steam was in the range 0.0 ~ 0.51 (calculated from volume-, weight, and energy-balance of the reservoir, on the assumption of thermodynamic equilibrium). The reservoir pressure, discharge flow rate, and the distributions of pressure, fluid temperature, and weight velocity along the test nozzle axis were measured. The experimental results are summarized as follows: (1) The observed discharge flow rate is smaller than the value calculated with saturated flow model, except in the range of quality below 0.01, and (2) The fluid temperature in the test nozzle was about 50°C lower than the saturated temperature, except in the regions near the inlet and outlet. These results indicate that non-equilibrium phase change occurred in the converging diverging nozzle of interest. (auth)

29250 CONDENSATION HEAT TRANSFER OF A BINARY LIQUID VAPOR. Mori, Y. (Tokyo Inst. of Tech.); Harada, T.; Uchida, M.; Hara, T. (Tokyo Inst. of Tech.). Nippon Kikai Gakkai Rombunshu; No. 320, 1298-1307(Apr 1973). (In Japanese).

An experiment was performed in order to provide the necessary data to design condensers for the magnetohydrodynamic generators using binary liquid metal as well as to clarify the characteristics of the binary liquid metal in condensation heat transfer by determining condensation heat transfer rate in forced convection in a pipe with regard to the binary liquid metal with a small quantity of impurities on the basis of radial temperature distribution in vapor. With this end in view, the experiment of the forced convective condensation heat transfer of ternary alloy vapor composed of mercury, bismuth, and lead in a loop was performed, and the measured radial temperature distribution in vapor brought about the following results: the condensation heat transfer rate of the binary liquid metal with small quantity of impurities was found to be nearly equal to that of one component liquid metal; the condensation heat transfer rate of the binary liquid metal with some uncondensed vapor was found to be lower than that without vapor; and to nearly agree with the calculated rate for one component liquid metal vapor. (JA)

29251 HEAT TRANSFER DURING CONDENSATION OF WET STEAM TO WATER. Benedek, S. (Villamosenergiaipari Kutato Intezet, Budapest). Waerme; 79: No. 5, 81-84(Oct 1973). (In German).

The conditions of heat transfer in several water-distribution systems were investigated and calculations for a contact heat exchanger are described. (INIS)

29252 VIBRATION OF CYLINDRICAL STRUCTURES INDUCED BY AXIAL FLOW. Paidoussis, M. P. (McGill Univ., Montreal). pp 197-278 of Recherches Actuelles et Applications Industrielles. Paris; Eyrolles (1973).

From fluid mechanics summer school; Ermenonville, France (4 Sep 1972).

The effect of axial flow on cylindrical structures is discussed. It is shown that axial flow may cause hydroelastic instabilities at sufficiently high flow velocities. However, for the range of flow velocities and other parameters pertaining to industrial systems, the effect of purely axial, uniform, steady flow is to damp free motions. Nevertheless, departures from such ideal flow conditions induce small amplitude vibrations, termed subcritical vibrations. The underlying mechanism of these vibrations is examined, and the various means available for predicting their amplitude are discussed. These latter are either empirical or analytical (generally semi-empirical); the analytical methods are further classified into three categories accordingly as they postulate the vibration to be forced, parametric, or self-excited. The measure of success achieved in predicting subcritical vibration amplitude is discussed, together with the reasons why the results obtained are generally poor. At present the amplitude may be predicted typically to within one order of magnitude. (FR)

29253 LOCAL, TRANSIENT BOILER-SURFACE TEMPERATURE BEHAVIOR IN SATURATED POOL-BOILING CRYOGENIC LIQUIDS (VOLUMES I AND II). Swanson, J. L. Boston; Northeastern Univ. (1973). 508p. University Microfilms Order No. 73-28,840.

Thesis (Ph. D.).

Local, transient boiler-surface temperature measurements made in saturated nucleate and film pool-boiling N_2 are related to the conventional steady-state heat flux-excess temperature behavior. The transient signals originated at an array of miniature thin-film thermometers vacuum-deposited on the surface of a pure, single-crystal sapphire boiler-sample. Data was acquired in discrete heat-flux increments as the nucleate and film boiling regions were traversed. Events precipitating the peak heat-flux and minimum film-boiling crises were observed. Individual bubble-induced temperature oscillations in the nucleate boiling region increased in frequency of occurrence and magnitude as the power level was raised, and exhibited the 4-stage growth process reported for other liquids, thus, suggesting that an evaporating microlayer heat transfer mechanism exists in

cryogenic liquids. A simplified bubble growth model was developed which shows that the evaporating microlayer contribution to bubble growth is small at low heat fluxes, but increases in significance at higher power levels. Predictions from the model were in reasonable agreement with observed departure diameters. An analysis showed that quenching could not account for the primary surface temperature drops. At approximately one-half of peak heat-flux power, bubble coalescence was observed, which also increased in frequency and magnitude with power, and led to the first crisis condition. Surface temperature oscillations in the stable film boiling regime had characteristics very similar to those observed in the nucleate boiling region, but were of much greater spatial magnitude and time scale. In the low film boiling region periodicity was apparent. Numerical amplitude-distribution and frequency distribution analyses were performed to establish a quantitative relationship between the transient and steady-state data. Single-sensor, uncalibrated, transient surface temperature measurements were obtained in liquid He. The bubble-growth behavior did not exhibit 4-stage process, and coalescence was not apparent, even at incipient peak heat fluxes. A clarification of the boiler thermal property influence is presented, and led to the prediction of a thermal property effect for some solids operating in liquid He. The criterion is in reasonable agreement with observed peak heat-flux property influences. The use of digital computer-oriented data acquisition and processing system made possible both temperature and time expansions and compressions for visual analysis. This unique capability allowed many illustrative graphical perspectives of the transient boiling data. (Diss. Abstr. Int., B)

Materials Testing

Refer also to abstracts 29404, 31296, and 31665.

29254 (RD/B/N-2854) ON-LINE PDP-11 ACOUSTIC EMISSION LOCATION ANALYSIS FOR A SYSTEM OF 3 TRANSDUCERS. Tobias, A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Dec 1973. 36p. Dep. NTIS (U. S. Sales Only) $5.00.

An acoustic emission location system based on a PDP-11 computer is described in terms of the operation of the present software. Limitations of the system are discussed and possible improvements are outlined. Despite these limitations it is shown that clearly defined source locations can be obtained from the analysis of acoustic emissions. A data input rate of ~1400 signals s^{-1} can be handled by the system without the introduction of dead time. It is therefore anticipated that the conditions of high noise, which are characteristic of reactors in service, will be accommodated by the system. (auth)

29255 (RFP-2060) NONDESTRUCTIVE EVALUATION CONCEPTS APPLIED TO INDUSTRIAL USE OF ACOUSTIC EMISSION. Drouillard, T. F.; Liptai, R. G.; Tatro, C. A. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.; California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jan 1974. 60p. (CONF-740117-1). Dep. NTIS $6.00.

From symposium on monitoring structural integrity by acoustic emission; Ft. Lauderdale, Florida, USA (17 Jan 1974).

Various nondestructive testing and evaluation concepts as applied to the industrial use of acoustic emission are presented. Emphasis is given to the characteristics of acoustic emission as a quique NDT method for use in the evaluation of the structural integrity of materials, components, and engineering structures. Also included is a brief review of some of the problems pertaining to the introduction of emission techniques to the industrial atmosphere. Several applications of acoustic emission testing are discussed. (auth)

29256 RADIATION PENETRATION TEST. Kannoo, A. (Ship Research Inst., Tokyo). Tokushuko; 22: No. 6, 32-36(Jun 1973). (In Japanese).

Radiation penetration tests are one of the nondestructive testing methods which are employed as a method of detecting internal defects with ultrasonic flaw detection. Of these, radiography is the most widely used method for defect detection, which produces two dimensional images of defects on x-ray films. Experimental investigations have been carried out for the defects to be detected, which include disc- and sphere-shaped defects and cracks. Thermal neutrons are sometimes employed according to purpose, as they can be applied to such materials as can be barely detected by x- and γ-rays, because of remarkable absorption in specific materials regardless of their density. Upgrading, labor saving, and automation of defect discrimination are future problems. Development of single purpose machines, a method to obtain the intensity of penetrating radiation in the form of electrical signals, and to control it automatically, and further, automatic evaluation of radiographs are expected developments in future, though it is difficult to realize today. (JA)

29257 STRESS WAVE SOURCE LOCALIZING EQUIPMENT. Bernard, P.; Chretien, N. (to Commissariat a l'Energie Atomique). French Patent 2,164,031. 10 Dec 1971. 16p. (In French).

Equipment is described for localizing small area stress wave emission sources. It consists of at least three detectors designed to press against the surface of the material studied at specially defined places. Each of these detectors is provided with a transducer furnishing an electrical signal whose amplitude depends on the stress waves; an amplifying and filtering unit is supplied for each detector; this unit provides a single pulse each time the threshold is exceeded; means are incorporated for determining the time interval between the instant when a pulse appears on one of the units and the occurrence of corresponding pulses on the other units from information about this instant. An important application of the invention is in the surveillance of reactor vessels. (FR)

29258 APPLICATION OF RESPONSE FUNCTION TO RADIOGRAPHY. Nojiri, T. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan). Genshiryoku Kogyo; 19: No. 6, 49-54(Jun 1973). (In Japanese).

Response functions are useful for the analysis of radiography systems for the quantitative evaluation of the transmission of information from objects to be radiographed to images on films. In the γ radiography, the films are exposed to secondary electrons generated by mutual action of the γ-rays with lead foil sensitizers, thus a sort of signal transformation is carried out. Accordingly, the response function, in which the radiation penetration characteristics of the objects to be radiographed and image-receiving film system are treated as frequency filters, can be utilized. Image quality is represented by sharpness or fading and granular property, and the evaluation of transmission of the former can be expressed with the response function based on Fourier analysis, while that of the latter with the Wiener spectrum. Examples of the measured values of response function for the image-receiving film system using radiation sources of ^{170}Tm, ^{192}Ir, ^{137}Cs, and ^{60}Co, and the optimum lead sensitizers for them are shown. In order to determine the response function of film system, radiation intensity changing sinusoidally is focused on the films, and the sinusoidal density distribution is examined. Another method is to examine the state of the extending images of point or line objects. Moreover, the spectra of radiation sources, the response function of scattered ray from objects to be radiographed, and the radiographed images with ^{192}Ir source are calculated. The Nitka index, resolution, and unsharpness for evaluating image quality can be derived by simple mathematical examination, if the response function of a system is known. (JA)

29259 APPLICABILITY RANGE OF ^{192}Ir SOURCES IN RADIOGRAPHY. Osuchowski, B. Post. Tech. Jad.; 15: No. 1, 49-59(1971). (In Polish).

Plots are shown for dose rates as functions of the thickness of the steel under investigation using two commercial film plates and specified geometrical arrangements. The geometrical arrangements required to obtain a sharp radiography image are discussed. Plots are shown for the dependence of steel thickness on focal distance under specified conditions. (Metals Abstr.)

Nuclear Explosions

Refer also to abstracts 29321, 29322, 29324, 29326, 29328, 29331, 29353, 29355, 29356, 29404, and 29768.

29260 (AD-769282) ANALYSIS OF A NUCLEAR-BURST BOUNDARY LAYER. Final Report, 21 October 1971–26 January 1973. Swift, R. P. (Physics International Co., San Leandro, Calif. (USA)). Oct 1973. Contract DNA001-72-C-0051. 61p. (PITR-384; DNA-3112-F). NTIS $3.50.

Calculations of a nuclear surface burst boundary layer for two yields differing by a scale factor of four are analyzed. The calculations were made with an Integral-Characteristic Code, and included the effects of radiative energy transfer, turbulence, and surface ablation. A thermal boundary layer is produced which substantially alters the near surface environment from that of the free field airblast flow. These altered conditions are examined from a viewpoint of how hardened structure and power system design criteria may be affected. One important effect that the calculations demonstrate is that a significant reduction in surface thermal conditions is achieved which prevents massive surface ablation. Another important effect illustrated is the large reduction of Mach number which takes place within the boundary layer. This raises the possibility of a potentially hazardous increase

in the blast pressure transmitted in air entrainment system ducts. (auth)

29261 (AD-769781) DNA EMP AWARENESS COURSE NOTES. Second Ed. (ITT Research Inst., Chicago, Ill. (USA)). Aug 1973. Contract DASA01-69-C-0095. 270p. (DNA-2772-T).

The notes are primarily intended as a guide for the individual attending the DNA EMP awareness course. The text serves as an engineering introduction to the EMP systems design problem and provides a survey of techniques suitable for solving this hardening problem. The text discusses all aspects of EMP, from the environment through system design and testing. (auth)

29262 (AWRE-O-11-74) PEACEFUL USES OF NUCLEAR EXPLOSIVES. Review Paper No. 1. Radioactivity and PNE. Lapage, R. (ed.). (UKAEA Weapons Group, Aldermaston, Atomic Weapons Research Establishment). Feb 1974. 114p. Dep. NTIS (U. S. Sales Only) $8.75. UK £2.

Published literature is compiled on the radiation hazards associated with uses of underground nuclear explosions for large-scale civil engineering projects, for mining, and for oil and gas stimulation. Following introductory material on cratering and contained nuclear explosion experiments, papers on the following subjects are presented: radioactivity production from underground nuclear explosions (using Plowshare data); the properties of radionuclides arising from device components, fission products, and the activation products of the surrounding rock; radiation exposure standards for defining the dose limits to human populations; exposure pathways due to radionuclide migration through soils, surface waters, the atmosphere, and ecosystems; distribution of localized radioactivity from contained and cratering explosions; distribution of fallout from nuclear cratering; precautions to be used during an explosion and on re-entry to the site; and a survey of decontamination methods. (LCL)

29263 (NVO-103(Rev.4)) REPORTS AVAILABLE IN THE ALASKAN INFORMATION PROGRAM. (USAEC Nevada Operations Office, Las Vegas). Jan 1974. 24p. Dep. NTIS $4.25.

A bibliography is presented of 186 documents in the "open files" at the Nevada Operations Office on subjects related to underground nuclear explosion testing on Amchitka Island. Information is included on the geology, archaeology, seismology, ecology, meteorology, hydrology, and oceanography of the area; the Cannikin and Milrow Projects; radiation monitoring activities; and safety considerations. (LCL)

29264 (NVO-1163-244) OBSERVED SEISMIC DATA, ALMENDRO EVENT. (Environmental Research Corp., Las Vegas, Nev. (USA)). Mar 1974. Contract AT(29-2)-1163. 29p. Dep. NTIS $4.00.

The Almendro Event was detonated on the Nevada Test Site (NTS) on June 6, 1973 with the explosion device emplaced 3490 ft below the ground surface in a rhyolite medium. Ground motion data were recorded at 51 stations located on the NTS, and in Nevada, Utah, and Arizona. The instrumentation and data processing are described. Tabulated data are presented on the peak velocities recorded, and the component azimuths of the stations. The 5% pseudorelative velocities vs. time period in sec are plotted for stations at varying distances from ground zero. (LCL)

29265 (ORNL-TM-4370, pp 392-397) CHEMICAL APPLICATIONS OF NUCLEAR EXPLOSIVES. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

Possible tritium behavior during the recovery of oil from shales broken with nuclear explosives was studied by exposing shale samples to tritiated water vapor and recovering oil from the contaminated shale in a bench-scale retort designed to generate a moving retorting front. (LK)

29266 (UCRL-51554) ROCK MELT FROM AN UNDERGROUND NUCLEAR EXPLOSION. Butkovich, T. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Mar 1974. Contract W-7405-Eng-48. 11p. Dep. NTIS $4.00.

Knowledge of the deposition of energy with distance around an underground nuclear explosion has significance in predicting chemical processes in the multimineralic rock substance surrounding the explosion. When a nuclear explosion is detonated, the shock wave that emanates from the explosion center does PdV work on the rock substance and deposits energy. Energy deposition due to the passage of the shock wave is determined from hydrodynamic code calculations which keep track of internal energy with distance and time. The energy distribution with distance depends on the compressibility of the rock. Rock of low density and high porosity requires a larger increase in internal energy to shock it to a given pressure than an essentially pore-free dense rock. Interpretation of hydrodynamic code calculations shows that 1000 to 1200 metric tons/kt of melt is produced from dense granite and that two to three times as much melt is produced from dry porous ash-fall tuff. Radiochemical analysis of melt samples recovered from near the shot point tend to confirm these results. (auth)

29267 (UCRL-Trans-10710) SELECTED TRANSLATIONS OF SELECTED ARTICLES ON EXPLOSIVELY CONSTRUCTED DAMS. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. Translated from Vzryvnoe delo–Sbornik No. 69/26, Moscow, 1970. 96p. Dep. NTIS $5.45.

Translations of seven Russian reports on the use of chemical explosions to construct dams and to excavate for roadway construction are presented. (LCL)

29268 MILITARY APPLICATIONS OF NUCLEAR TECHNOLOGY. Part 2. Hearings Before the Subcommittee on Military Applications of the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, First Session on the Consideration of Military Applications of Nuclear Technology, May 22 and June 29, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 139p. GPO $1.20.

29269 NUCLEAR EXPLOSIVES IN PEACETIME. Scientists' Institute for Public Information Workbook. New York; Scientists' Institute for Public Information (1970). 28p.

The feasibility, benefits, risks and problems of peacetime uses of nuclear explosives are reviewed. Projects discussed include gas well stimulation, excavation, construction of underground storage cavities, and construction of a new Isthmian Canal. Weapon testing is also discussed. (TFD)

29270 WEAPON EFFECTS TESTS: PLANNED EMERGENCIES. Rarrick, H. L. (Sandia Labs., Albuquerque, NM). pp 1573-1580 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Procedures for cleanup and reentry of areas used in weapon effects experiments are described. (TFD)

29271 PROJECT GASBUGGY OPERATIONAL EXPERIENCES. Kase, K. R.; Greenhouse, N. A.; Silver, W. J.; Norman, G. R. (Univ. of California, Livermore). pp 47-65 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The health physics aspects of Project Gasbuggy, the first experiment conducted in the Plowshare underground engineering program are discussed. The project involved emplacement and detonation of the nuclear explosives, followed by a drillback into the gas formation and subsequent flow testing of the gas well. The health physics program was based on the preshot hazards analysis. It involved establishing an array of monitoring stations around the shot point to detect any fission product effluent, a monitoring and sampling program for gaseous and liquid effluent from the postshot drilling operation, and monitoring and documentation of radioactive material released during the gas flow tests. The effluent monitoring program required continuous on-line detector/readout systems for monitoring primarily ^{131}Xe in the early postshot period and ^{85}Kr and ^{3}H at later times. The capability for detecting ^{3}H and ^{131}I was necessary at all times in the postshot program. To accomplish this monitoring program, several detector systems were developed for continuous effluent monitoring, and a trailer was equipped as a fairly sophisticated counting laboratory with capability for gross α and β counting, γ pulse-height analysis, liquid scintillation counting, and thyroid scanning. The equipment used in the monitoring program, problems involved with operating a health physics program under adverse field conditions, and the quantity and quality of radioactive material observed and released to the environment during the Gasbuggy experiment are described. (auth)

29272 EFFECTS ON POROSITY AND SATURATION ON SHOCK-WAVE RESPONSE IN TUFFS. Crowley, B. K. (Univ. of California, Livermore). Int. J. Rock Mech. Mining Sci.; 10: No. 5, 437-464(Sep 1973).

The attenuation of a stress-wave as it propagates through tuffaceous rocks of various porosities and degrees of saturation is investigated by a calculational parameter study. First, the equations of state for the various porous and saturated tuffs considered are construced from: approximations of the loading curves for tuffs at various grain densities; the weight per cent

of water under consideration; a loading curve for water; and estimates of loss of gas-filled porosity during loading. Then, these constructed equations of state are used in one-dimensional calculations to examine how peak radial stress and peak particle velocity are affected by porosity and saturation. The investigation was limited to the regions where peak radial stress is below about 40 kbar. The results show that the peak stress at a given distance from the working point decreases over the range from rock at grain density to rock with small amounts of either water or open void space. The first 5 per cent of volume given up to either void or water is most effective in decreasing the stress at a given distance; additional proportions of either void or water produce relatively less effect. Open void is substantially more effective than water-filled space in producing stress-wave attenuation: a few per cent of dry void volume has the same effect on attenuation as several times as much volume of water with no void. When either the gas-filled or total porosity of a material drops below about 5 per cent, peak stress at a given distance is markedly increased. Above about 5 per cent, the peak stress is relatively insensitive to either the gas-filled or the total porosity of a material. The attenuation of peak particle velocities is somewhat similar to stress attenuation through the rock. However, the particle velocity is less sensitive than stress to changes in void fraction or saturation of the rock. (auth)

29273 NUMERICAL SIMULATION OF TSUNAMIS. Mader, C. L. (Univ. of Hawaii, Honolulu). J. Phys. Oceanogr.; 4: No. 1, 74-82(Jan 1974). (LA-UR-73-1438).

Two-dimensional, time-dependent, nonlinear, incompressible, viscous flow calculations of realistic models of tsunami waves interacting with continental slopes and shelves were performed. Wave heights were observed to grow by a factor of 4 as they shoaled up a 1:15 continental slope. The second or third wave often exhibited the largest wave run-up. Comparisons with shallow water, long-wave calculations showed similar results except for short wavelength tsunamis. The damping action of submerged barriers on tsunami waves was investigated. Significant amounts of the energy of a tsunami may be reflected by submerged barriers. The numerical simulation of tsunami waves can provide realistic descriptions of their flow. (auth)

29274 AFTERSHOCKS CAUSED BY THE NOVYA ZEMLYA EXPLOSION ON OCTOBER 27, 1973. Israelson, H.; Siunga, R.; Dahlman, O. (Foersvarets Forskningsanstalt, Stockholm). Nature (London); 247: No. 5441, 450-452(15 Feb 1974).

In the autumn of 1973 seismic signals were recorded at Novaya Zemlya from three underground nuclear explosions in the Arctic Ocean. One of these explosions was followed by a series of ten small events all of which occurred within 4 hr of the explosion. The locations of the explosions and the after events were determined based on data from Nordic and North American stations and discrimination results obtained at the Swedish Hagfors Observatory. The epicenters were obtained by a joint location technique utilizing arrival times of seismic P and S phases. Two of the explosions were located about 200 km south of the main test site of Novaya Zemlya, where the third explosion was fired. No surface waves were detected for the after events. The after event signals were complex compared with the simple pulselike waveforms of the explosion, and the explosions and after events appeared to represent different types of seismic sources. Two different types of aftershock activity are known. The first is associated with cavity deterioration and the events are located in the immediate vicinity of the cavity; they are observed soon after the explosion and continue until the cavity completely collapses. The second type represents explosion stimulated tectonic events, which may occur at distances >10 km from the explosion and have been observed months later. The tectonic events appear to be generally weaker than those related to cavity deterioration. From the observations it is concluded that the observed signals came from events related to cavity deterioration, but no event that could be associated with complete collapse of the cavity has so far been observed. (UK)

Protective Structures and Equipment

Refer also to abstract 29783.

29275 (LA-5488) SELECTION OF RESPIRATOR TEST PANELS REPRESENTATIVE OF U. S. ADULT FACIAL SIZES. Hack, A.; Hyatt, E. C.; Held, B. J.; Moore, T. O.; Richards, C. P.; McConville, J. T. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1973. Contract W-7405-eng-36. 32p. Dep. NTIS $4.00.

As requested by the National Institute for Occupational Safety and Health (NIOSH), the Los Alamos Scientific Laboratory Respirator Research and Development Section, Industrial Hygiene Group, has prepared anthropometric specifications for subjects to test the fit of half-mask, quarter-mask, and full-facepiece respirators. A facial survey of 200 males was conducted, with results similar to those of a recent survey of some 4000 U. S. airmen. Subjects were selected on the basis of face length and face width to wear full-face masks in tests. For testing half- and quarter-masks, face length and lip length were used. Test panels containing 25 male-and-female subjects were used to represent a majority of the working population. A sequential sampling scheme was developed to reduce the amount of testing required to determine if a mask provides adequate protection for different facial sizes. Examples of man test results are given. (auth)

29276 (ORNL-TM-4463) HIGH-EFFICIENCY PARTICULATE AIR FILTERS: STATE OF THE ART SUMMARY PERTAINING TO PLUTONIA AEROSOLS. Davis, W. Jr. (Oak Ridge National Lab., Tenn. (USA)). Apr 1974. Contract W-7405-eng-26. 10p. Dep. NTIS $4.00.

High-efficiency particulate air (HEPA) filters now being manufactured commercially routinely exceed the specification of removing 99.97% of 0.3 μ-diameter particles of a monodisperse dioctyl phthalate (DOP) aerosol. Laboratory tests indicate that when such filters are properly installed in series, at least up to three, each will perform at this same level with plutonia aerosols, leading to decontamination factors in excess of 3×10^{10}. Filter media that are resistant to serious degradation by hydrogen fluoride and fluorine are now in the process of assembly into filter units for testing. (auth)

29277 EFFECTIVENESS OF WASTE AIR CLEANING IN THE FABRICATION OF FUEL ELEMENTS FROM ENRICHED URANIUM. Andreeva, O. S.; Bolotin, Yu. A.; Parkhomenko, G. M.; Tal'yanskii, E. D. (Inst. of Biophysics, Moscow). pp 55-61 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The development of nuclear power engineering and the increase in the number of nuclear power stations have made it necessary both to enlarge fuel element fabrication capacity and to ensure the radiation safety of operating personnel and of the population living in the vicinity of such plants. From an examination of different methods of waste air cleaning it has been possible to determine the best way of removing alpha-active aerosols produced by ^{234}U, ^{235}U, and ^{238}U. Local cleaning of the air removed from equipment (by a filter installed within the same housing) together with subsequent general cleaning provides for adequate radiological protection in operating the filters within the plant and reduces radioactive contamination outside to levels not exceeding the average permissible concentration for the atmosphere (4.4×10^{-15} Ci/liter). (auth)

29278 EFFECTIVENESS OF FILTER MEDIA FOR SURFACE COLLECTION OF AIRBORNE RADIOACTIVE PARTICULATES. Denham, D. H. (Battelle Pacific Northwest Labs., Richland, WA). pp 1093-1105 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

The relative surface collection efficiencies of cellulose, cellulose-asbestos, and glass fiber filters were determined for alpha activity by comparison with a membrane filter reference. Alpha activity determinations made from air samples collected on cellulose filters may be less than one-half of the activity determined from these same samples by dissolution and alpha counting of the resultant solution. Beta activity determinations made on the downstream side of air sampling filters yielded results as low as 50% of those determined from the upstream side of the filter. Glass fiber filters were found to have 15 percent greater surface collection efficiency than the popular cellulose-asbestos filters. (auth)

29279 EMERGENCY DECONTAMINATION FACILITIES. Yesberger, G. R. (Atomic Energy Commission, Richland, WA). pp 1509-1520 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

The "SL-1" criticality accident provided an opportunity for atomic energy installations to examine their capabilities and facilities for handling such an accident. It became apparent to Hanford personnel that they were unprepared for such an

occurrence and corrective measures were initiated. The resulting radiosurgery and decontamination facilities are described. (TFD)

Safety Engineering

29280 (UCRL-50007-73-3) HAZARDS CONTROL PROGRESS REPORT NO. 47, SEPTEMBER–DECEMBER 1973. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Feb 1974. Contract W-7405-eng-48. 30p. Dep. NTIS $4.00.

Progress and technical notes on the following topics are given: cartridge and canister test system for the respirator testing and certification laboratory; HEPA filter fire protection smoke plugging problem; neutron spectrometer; x-ray polarization studies; x-ray fluorescence analysis for nuclear materials security; air sampling for 4,4-methylene (bis) 2-chloroanaline (MOCA) liberated from curing adiprene adhesive L100; air sampling for toluene diisocynate (TDI) liberated from the adiprene adhesive L315; and response of mine surface coating to a fire. (TFD)

Vacuum Engineering

Refer also to abstract 29614.

ENVIRONMENTAL AND EARTH SCIENCES

29281 ENERGY, THE ENVIRONMENT AND NUCLEAR ENERGY LABORATORIES. Liverman, J. L. (Atomic Energy Commission, Washington, DC). pp 1-24 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

Three issues that derive from the apparent conflict between the demand for more energy by the earth's people and the simultaneous requirement to maintain a healthy environment are at the core of the discussion here. The nature of the public concern for the environment and how it arose, the demand for energy, both in the United States of America and in the rest of the world, and the nature of the institutions seemingly best suited to understand and resolve these concerns are discussed. (auth)

Minerals and Ores

Refer also to abstracts 29295, 29776, 29842, and 31143.

29282 (AEC-tr-7530) URANIUM MINERALIZATION IN CARBONACEOUS SEDIMENTARY ROCK. Danchev, V. I.; Kornilov, A. M.; Neymyshev, M. V.; Ol'kha, V. V.; Proshlyakov, B. K.; Strelyanov, N. P.; Sytnikov, M. P. Translated from Geol. Rud. Mestorozhd.; No. 6, 27-38(1959). 20p. Dep. NTIS $4.00.

The results are presented from studying uranium deposits coordinated with the carbonaceous rock of the lower Tertiary. It is concluded that the formation takes place in close connection with the formation of the country rock. A study was made of the role of the processes of sediment accumulation, diagenesis and epigenetic variations in the formation of the ore deposits. (auth)

29283 (AEC-tr-7531) URANIFEROUS DOMAIN OF THE FRANCEVILLE BASIN (REPUBLIC OF GABON). Bourrel, J.; Pfiffelmann, J. P. Translated from Miner. Deposita; 7: 323-336(1972). 21p. Dep. NTIS $4.25.

The sedimentary series of the Precambrian Franceville Basin (Republic of Gabon) consists of two successive pelite-sandstone cycles. This series, which is 1,000 to 1,500 meters thick, fills a "pre-trough" basin formed by regular subsidence. The uranium mineralization is contained in the upper part of the base sandstone. The origin of the uranium in the deposits which have been discovered is attributed to leaching of mineral-rich rocks (bed or volcanic strata) and the seeping of the resulting solutions into sedimentary tectonic traps. (auth)

29284 (CONF-730985-) AEC NUCLEAR INDUSTRY SEMINAR, GRAND JUNCTION, COLORADO, SEPTEMBER 6–7, 1973. (USAEC Grand Junction Office, Colo.). 1973. 293p. Dep. NTIS $16.75.

Thirteen papers were presented at the seminar. A separate citation was prepared for each paper. (LCL)

For abstracts of individual papers see: 29285–29291, 29622, and 31423–31427.

29285 (CONF-730985-, pp vp, Paper 3) U. S. URANIUM ORE RESERVES. Appelin, C. W. (Atomic Energy Commission, Washington, DC). 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

29286 (CONF-730985-, pp vp, Paper 4) POTENTIAL URANIUM RESOURCES OF THE WESTERN U. S. (Atomic Energy Commission, Grand Junction, CO). May 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

29287 (CONF-730985-, pp vp, Paper 5) URANIUM EXPLORATION EXPENDITURES IN 1972 AND PLANS FOR 1973–74. (Atomic Energy Commission, Grand Junction, CO). May 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

The USAEC conducted a survey which compiled data from 84 companies on uranium exploration expenditures from 1966 to 1973 and planned expenditures through 1974. Tabulated data on these expenditures are presented and explained. (LCL)

29288 (CONF-730985-, pp vp, Paper 6) URANIUM PRODUCTION STATISTICS. Facer, J. F. (Atomic Energy Commission, Grand Junction, CO). Sep 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

Uranium mining and milling during 1973 are discussed. Ore production at 6.7 million tons was at its highest annual rate since 1962. However, because of a decrease in grade, the U_3O_8 contained in the ore produced in 1973 was about the same as that in 1972. Graphical data are presented for 1966 through 1973 on ore shipments, ore grades, U_3O_8 in the concentrate produced, and the amount of U_3O_8 in concentrate inventories. A separate short discussion is presented on recent developments in methods for recovering uranium from wet process phosphoric acid and from copper dump leach liquor and on the economics of such uranium recovery. (LCL)

29289 (CONF-730985-, pp vp, Paper 7) DOMESTIC PRODUCTION CAPABILITY (AS OF JANUARY 1, 1973). Barnes, C. H. (Atomic Energy Commission, Grand Junction, CO). Sep 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

During 1972 some 200 mines produced more than 6.5 million tons of ore containing about 13,500 tons of U_3O_8. At the end of the year 20 mills existed, 18 of which were in production, one was on standby, and one was producing only vanadium. Demand was some 8,000 tons, while mine-mill capability was about 19,000 tons. There are no new mills either under construction or announced; consequently all production for the coming 2 to 4 years will probably come from these facilities. Employment as of 1/1/73 was 6,400; 3,720 in mining, 1,530 in milling, and 1,150 in exploration. Approximately 17.7 million acres were under lease as of 1/1/73 for mining and exploration purposes as compared to 24.4 million acres two years earlier and 19 million last year. Drilling in 1972 totaled 15.4 million ft, about the same as for 1971, and down from 23.5 million ft in 1970. (auth)

29290 (CONF-730985-, pp vp, Paper 8) SOME FINANCIAL ASPECTS OF THE DOMESTIC URANIUM MINING AND MILLING INDUSTRY OVER THE NEXT FIFTEEN YEARS. Klemenic, J. (Atomic Energy Commission, Grand Junction, CO). Sep 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

The cost of developing uranium reserves is discussed in terms of the projected amount of reserves needed to 1987, total expenditures in operating and capital items, expenditures for exploration, mining, hauling, and milling, unit cost in the form of $/lb of U_3O_8 in the concentrate, and the required price of U_3O_8 to achieve a 10% rate of return on investment. (LCL)

29291 (CONF-730985-, pp vp, Paper 10) FOREIGN URANIUM RESOURCES AND SUPPLY. Nininger, R. D. (Atomic Energy Commission, Washington, DC). 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

Graphical data are presented the world-wide (excluding Communist Bloc countries) distribution of known uranium deposits, the status of deposit development, total tons of U_3O_8 at $10/lb estimated in the reserves, world-wide U requirements through the year 2000, foreign and US uranium production capability to year 1985, and foreign uranium exploration activity. (LCL)

29292 EXPERIENCE WITH THE APPLICATION OF FIELD GAMMA SPECTROMETRY. Altyncev, J.; Anft, A.; Kornilov, F.; Stara, S. (Czechoslovak Uranium Industry, Pribram). ([nd]). vp. (In Czech.).

From symposium on the mining Pribram in science and technique 1972; Pribram, Czechoslovakia (1972).

The determination of the content of U (Ra), Th, and K by gamma spectrometry represents another stage in the development of radiometric methods of mineral prospecting and of geological mapping. A survey is presented of geological and chemical prerequisites for the application of gamma spectrometry, of its physical and methodical characteristics, and of the first positive experience with its application. (Nucl. Sci. Abstr. Czech.)

Radioactive Effluents

Refer also to abstracts 29198, 29201, 29202, 29488, 31146, and 31432.

29293 (ORNL-TM-3899) EFFLUENT CONTROL IN FUEL REPROCESSING PLANTS. Yarbro, O. O.; Harrington, F. E.; Joy, D. S. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 61p. AT.

A study is reported on how extrapolations of current and developing technology might be applied to the task of reducing radioactive effluents from future fuel reprocessing plants to "near zero." The study indicates that significant reductions of effluents can be achieved by integrating advanced effluent control systems with new concepts of containment and ventilation that would reduce net inleakage of air to the process enclosures and provide for extensive recycle of gases and liquids. If net plant effluent flow rates can be thus reduced and if the highly efficient fission product removal systems, under development, do in fact become available, it should be possible to reduce the discharge of activity to the environment in future plants by four to six orders of magnitude. Overall plant retention factors in the order of 10^{10} for iodine, 10^5 for tritium and krypton, and 10^{14} to 10^{16} for particulates appear possible. (auth)

29294 ASSESSMENT OF POPULATION EXPOSURES. Lindell, B. (Swedish National Inst. of Radiation Protection, Stockholm). pp 25-34 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The conventional method of relating assessments of radiation doses in the environment to dose limits applicable to the most highly exposed individuals (i.e., the "critical group") will not be sufficient when the number of nuclear power reactors is rapidly increasing. Additional methods of assessment, designed to facilitate the control of the future situation, include concepts such as "collective dose," "population dose" and "dose commitment" per unit practice (e.g., man-rems per MW·year). These concepts are discussed in relation to risk-benefit and cost-benefit evaluations in source-related assessments. (auth)

29295 PRE-OPERATIONAL ASSESSMENT OF THE DISCHARGE LIMITS AND RELATIVE IMPORTANCE OF RADIOACTIVE AND OTHER WASTES FROM URANIUM PRODUCTION IN AUSTRALIA'S NORTHERN TERRITORY. Davy, D. R.; Giles, M. S.; Conway, N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). pp 37-54 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The sources and nature of the wastes likely to arise from the uranium extractive industry now being developed in the Northern Territory of Australia are examined. The area in question is tropical and has a season of monsoonal rain with heavy run-off, which alternates with a long dry season. In the dry season river flow is minimal and parts of the river systems become isolated and subject to heavy loss from evaporation. In consequence, the environmental problems associated with the uranium mines and mills are unusual. Ecological mapping to define sensitive habitats and toxicity studies undertaken on sensitive species indicate that the levels that can be allowed for heavy metals will dictate criteria for treatment and containment of wastes from extraction plants. On the other hand, radiological considerations will govern disposal of pit water and run-off from storage and overburden dumps. The naturally occurring levels and transfer mechanisms have been examined for uranium, radium and lead. These characteristics can be used to assess the environments of particular mines. For each of four probable mine locations four possible exposure routes for ^{226}Ra and ^{210}Pb can be identified and have been evaluated separately. Although their local environments are very similar, the critical exposure routes differ for at least three of the possible mine sites. This is because transfer and dispersion mechanisms, and land use, differ between the sites. (auth)

29296 PRELIMINARY EXPERIMENT ON THE DEPOSITION OF GASEOUS RADIOIODINE ONTO ENVIRONMENTAL MATERIALS. Miyanaga, I.; Kasai, A.; Imai, K. (Japan Atomic Energy Research Inst., Tokai). pp 157-165 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The deposition rates of gaseous radioiodine onto some environmental materials were measured experimentally with the use of an air-circulating chamber of dimensions 1.0 m × 1.5 m × 2.0 m. The circulating air speed and relative humidity are controllable in the ranges of 0 to 5 m/s and 50 to 100%, respectively, and a water spray device was set in the ceiling. To simulate the composition of airborne radioiodine released from the stack of a fuel reprocessing plant or radioisotope production plant, carrier-free Na ^{131}I was oxidized in 10N HNO_3 solution and the gas generated was introduced into the chamber after being scrubbed in NaOH solution by continuously bubbling N_2 carrier gas. The composition of ^{131}I compounds in the chamber was analyzed by radio-gas-chromatography. At the start of injection, dominant components were the inorganic iodides, HIO_3 and HIO_4, and then the fraction of organic iodides increased and remained at about 80% after about four hours had elapsed. Averaged concentrations in the chamber were in the range 10^{-6} to 10^{-7} μCi/ml and exposure durations were 6 to 7 hours. The environmental materials used were soil, sand, water, vegetables and pine tree leaves. The deposition velocity was determined as the ratio of the deposit per unit area of the surface of the materials to the accumulated concentration in air. The values obtained were in the range 10^{-2} to 10^{-3} cm/s and they decreased in the sequence soil, sand, vegetables, water. Converting the values for the vegetables to values for vegetation per unit area of the ground by using data on area density of vegetation, the deposition velocity to the vegetation was estimated to be almost the same as that to soil. (auth)

29297 TRITIUM: HISTORY OF DISCOVERY, APPLICATION, AND HAZARDS TO THE ENVIRONMENT. Moghissi, A. (National Environmental Research Center, Las Vegas, NV); Moghissi, B. Phys. Bl.; 29: No. 12, 543-547(Dec 1973). (In German).

The radionuclide tritium has met with increasing interest in the last few years, as considerable quantities of this radionuclide are being released from various types of reactors. A synopsis of the discovery of natural tritium after its preparation by Rutherford, and its utilization in the fabrication of liquid scintillation detectors and other instruments by Kallmann and co-workers is presented. Tritium is used as a tracer substance in various fields of chemistry, biochemistry, biology and medicine. The production of tritium in nuclear reactors is reviewed and the need for a critical surveillance of the environment of such nuclear plants is explained by discussing the biological effect of tritium, which still remains unclarified to a large extent. An important aspect in this discussion is the isotope effect. (GE)

Radioactivity Monitoring and Transport

Refer also to abstracts 29040, 29176, 29203, 29262, 29522, 29776, 29778, 29837, 29845, 29852, 30193, 31146, 31371, 31584, 31585, and 31593.

29298 (BNWL-1850(Pt. 2), pp 121-122) RADIOLOGICAL-HEALTH RESEARCH. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

This project involves a continuation of the environmental study to measure the decline of radioactivity in various population groups and to reduce, compute, analyze and report the environmental information from these new studies. (auth)

29299 (INIS-mf-887-1, pp 2-24) RESEARCH INTO RADIOISOTOPE CONTAMINATION OF THE LIVING ENVIRONMENT IN RUMANIA. Szabo, A. [nd]. (In French).

The research efforts are characterized of the Radioactivity Laboratory of the Institute of Stable Isotopes in Cluj (Rumania) in the field of the living environment contamination with natural and artificial radioisotopes. A brief review is presented of the methods used by the Institute for the determination of radon, radium, uranium, thorium, potassium-40, lead-210 and the total beta and gamma activity and the methods of radioisotope analysis are described. Main results are reportedly obtained during the past twenty years of the activities of the Institute in the monitoring and the measurement of radioactive contamination. (INIS)

29300 (STI/PUB-345) ENVIRONMENTAL BEHAVIOR OF RADIONUCLIDES RELEASED IN THE NUCLEAR INDUSTRY. Proceeding Series. Proceedings of a Symposium Held in Aix-en-Provence, France, May 14–18, 1973. (International Atomic Energy Agency, Vienna (Austria)). Dec 1973. 759p. (In Several Languages). (CONF-730503-). IAEA $34.00.

Forty-eight papers were presented. A separate abstract was prepared for each of 43 papers. Five papers were abstracted previously in NSA. For abstracts of these see CONF-730503- in the Report Number Index. (LCL)

For abstracts of individual papers see: 29201–29203, 29277, 29281, 29294–29296, 29301–29310, 29334–29336, 29344, 29359–29365, 29375–29385, 29850, 29867, and 30193.

29301 PRINCIPLES OF ENVIRONMENTAL MONITORING AT NUCLEAR POWER STATIONS. Pellerin, P.; Moroni, J. P. (Centre International de Reference pour la Radioactivite, Le Vesinet, France). pp 111-125 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The development of radiation protection as an accompaniment to that of nuclear power generation is reviewed and the efforts in this field with those made to combat conventional forms of pollution are compared. The principles of environmental monitoring at nuclear power stations that have emerged during the growth of nuclear power generation are set forth; they should serve as a model for the surveillance of conventional forms of pollution. The results of current environmental monitoring are discussed, it being noted that contamination of the environment and of man through the operation of nuclear power stations is at present so slight as to be virtually undetectable. The need for a more objective assessment of the risks associated with nuclear power generation, which have been reduced to a minimum by—in particular—the control and monitoring arrangements instituted by public health authorities is discussed. (auth)

29302 U. S. ATOMIC ENERGY COMMISSION PROGRAM FOR MONITORING THE BEHAVIOR OF RADIONUCLIDES RELEASED TO THE ENVIRONMENT. Welty, C. G. Jr.; Biles, M. B. (Atomic Energy Commission, Washington, DC). pp 139-156 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The US Atomic Energy Commission (AEC) conducts major nuclear energy programs at about 30 sites. The environmental monitoring programs at these sites are conducted by AEC or its operation contractors and are governed by general requirements set forth in AEC management directives. The objective of these directives is to ensure that environmental monitoring is adequate to determine the extent to which levels of radioactivity released from AEC facilities comply with applicable environmental quality standards and to evaluate the effects, if any, of planned and unplanned releases on the environment. Emphasis has been placed on the monitoring of pathways of human exposure, although environmental media such as soil and sediment have been monitored to detect significant trends in radioactivity levels. In some instances direct gamma body counts on members of the public and hypothetical dose estimates for selected individuals and population groups have been made to define more accurately the risks of public exposure in the vicinity of AEC facilities. Environmental monitoring programs have generally demonstrated public exposures in the vicinity of AEC facilities to be less than one per cent of the ICRP recommended standards. Some operations, however, have resulted in potential public exposures representing somewhat larger fractions of the ICRP recommended standards. The levels of exposure that resulted from these and other AEC operations will be discussed. With few exceptions, exposures to individuals and groups in the population have not ranged above a few per cent of the ICRP standards. Comprehensive soil and sediment monitoring is being accomplished in the vicinity of a number of AEC facilities and sites to determine the degree of build-up of plutonium in the environment due to routine and accidental releases. There is no evidence that build-up of plutonium in soil and other media present a public health hazard. The quantities of plutonium released and the levels of plutonium detected in the environment will be discussed. (auth)

29303 MECHANISMS FOR THE TRANSFER TO CULTIVATED SOILS OF RADIONUCLIDES DISCHARGED BY NUCLEAR POWER STATIONS INTO THE SYSTEM: RIVER-IRRIGATED SOIL-GROUNDWATER. Saas, A.; Grauby, A. (CEA de Cadarache, St-Paul-lez-Durance, France). pp 255-269 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In French).

The siting of nuclear power stations on the banks of rivers whose water is used for irrigation and industrial and domestic consumption must be preceded by a study in depth of the mechanisms of transfer in the system comprising the river, irrigated soil and groundwater. The mechanisms of transfer to cultivated soils are considered basically from three viewpoints: the influence of the quality of the river water, irrigation channel water and groundwater on radionuclide mobility in soils; the influence of the type of soil (four types have been considered: brown acid soil, brown calcic soil, brown calcareous soil, and alluvial calcareous soil) and the development and distribution of radionuclides in the soil (water-soluble forms liable to contaminate the groundwater and the more labile forms available to plants). The study described relates to the following radionuclides: ^{22}Na, ^{137}Cs, ^{85}Sr, ^{54}Mn, ^{59}Fe, ^{60}Co, ^{65}Zn, ^{124}Sb, ^{141}Ce, and ^{131}I. Knowledge of the transfer mechanisms in cultivated soils permits an evaluation of the risks of contamination of the food chain and the groundwater. This study also demonstrates new aspects of the behavior of radionuclides as a function of the organomineral pollution by industrial and domestic waste of the water into which they are discharged. This pollution has a considerable effect on the formation of stable complexes transferred by the river to irrigated soils. The quality of the water determines the distribution of the radionuclides in the profile. The water-soluble complexes persist in the soil and migrate towards the groundwater if they are not biodegradable or are only slightly so. The stability of these complexes as a function of the pH of the soil and its physico-chemical characteristics and the radionuclides concerned can be used as a basis for drawing up a new balance of the radiological capacity of soils and for formulating new proposals for regulating nuclear power station siting. (auth)

29304 ACCUMULATION AND REDISTRIBUTION OF RADIOCESIUM BY MIGRATORY WATERFOWL INHABITING A REACTOR COOLING RESERVOIR. Brisbin, I. L. Jr.; Geiger, R. A.; Smith, M. H. (Univ. of Georgia, Aiken). pp 373-384 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

Changes in whole-body burdens of radiocesium were studied in monthly samples of American coots (Fulica americana) and other species of migratory waterfowl inhabiting a 2800-acre reactor cooling reservoir on the AEC Savannah River Plant near Aiken, South Carolina, USA. In October newly arrived coots averaged between 4–8 pCi radiocesium/g live weight and approximated a 50–50 sex ratio. Between October and January the sex ratio of the coots rose steadily to a maximum of 87% males as the females continued to move on to more southerly wintering grounds. In the predominantly male population remaining on the reservoir, radiocesium body burdens continued to rise at a rate of approximately 2 to 3 pCi/g per bird per month, to a maximum of between 15 to 20 pCi/g. From February through April the predominantly male population of coots began to leave for northern breeding grounds and were apparently replaced by populations that had wintered further to the south and had a higher percentage of females. As a result, the sex ratio began to decline until it once again approximated 50–50 in the late spring. Since these spring transient birds had not wintered on the reservoir, they had lower radiocesium contents. Thus, the average body burden of the coot population began to decline to a level closely approximating that of the first birds to arrive in fall. Simply sampling the first and last coots seen on the reservoir would have failed to detect the radioisotope build-up shown by the winter resident birds. In any given month, the radiocesium content of the coots was generally higher than that of any of nine other species of waterfowl and aquatic birds sampled. The higher body burdens of the coots may be related to their tendency to rely heavily upon submerged aquatic plants as a food resource. Migratory waterfowl may remove up to 3.75×10^{-6} Ci of radiocesium from the reservoir each year and redistribute it elsewhere along their migratory pathways. The radiocesium levels found in these birds do not indicate any present health hazard to the general public who may use them for food. (auth)

29305 MODELLING THE REGIONAL TRANSPORT OF RADIONUCLIDES IN A MAJOR UNITED STATES RIVER BASIN. Fletcher, J. F. (Hanford Engineering Development Lab., Richland, WA); Dotson, W. L.; Peterson, D. E.; Betson, R. P. AT(45-1)-2170. pp 449-465 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

A comprehensive study of the radiological implications of large-scale use of nuclear power generation, addressed to the Tennessee-Cumberland River Basins in the year 2000, is being undertaken. In

the course of this study computer modelling techniques have been developed to evaluate the movement of radionuclides, by water and air transport, from points of release at a large number of plant sites and to calculate patterns of radionuclide concentration throughout the region of study. Air transport calculations utilize a modification of the bivariate normal equation, with the vertical parameter σ_z characterized as a function of distance from the source, stability and mixing layer depth. Local variations in air flow caused by major terrain features are modelled. Depletion of the airborne radionuclides by wet and dry precipitation processes is accounted for and the concentrations of deposited radionuclides are calculated. The model sums contributions from all sources to provide resultant patterns of concentration of airborne and deposited radionuclides, including contributions from radionuclides deposited in prior years. The water transport model calculates steam concentrations of radionuclides in solution and absorbed on sediments. Effects of flow stratification and sediment trapping in reservoirs are considered. The solution of air-deposited radionuclides and their subsequent transport in ground and surface waters are modelled. Calculational routines are provided for simulating radionuclide transport in each stream in the basin and for calculating the resultant concentrations in solution and associated with suspended and deposited sediments. Together, the air and water transport models are designed to calculate regional patterns of radionuclide concentrations in the environment that result from the operation of nuclear facilities in a region. These concentration patterns can then be applied to the evaluation of radiological dose to man. (auth)

29306 RADIOECOLOGICAL STUDY OF THE RHONE BASIN: STRATEGY AND BALANCE SHEET. Bovard, P. (CEN, Fontenay-aux-Roses, France); Grauby, A.; Fouquier, L.; Picat, P. pp 507-523 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

A special feature of the Rhone Basin is that its area of 120,000 km^2 includes all types of nuclear industrial activity. For about 15 years past some tens of thousands of persons have been handling and have been in a position to discharge radionuclides at several nuclear research centers and institutes, two fuel fabrication plants, a uranium enrichment plant, an irradiated fuel reprocessing plant, several nuclear power reactors and various other nuclear facilities. To this list must be added two power reactors under construction and several reactors in the planning stage. As regards power reactors, another original feature of the Basin is that along one and the same river three types of industrial reactor—graphite-gas, light-water and breeder—are in operation or under construction. In view of the foreseeable quantity of discharges, the authorities responsible for nuclear development initiated some 10 years ago a radioecological study, the strategy of which involved two-fold action: to identify the pathways followed by the radionuclides discharged into the Basin from the whole nuclear complex and thereby to determine the critical points of the Basin, which could be used for guidance in future siting; and to verify the observations and estimates in the Basin itself at the critical points selected, and to modify the location of those points in the light of the results obtained and of new projects in the Basin as a whole (hydraulic works, new use of water). From numerous experiments and measurements carried out in situ it was found that the environment has in fact "accepted" the discharges but in the context of this conclusion, which is optimistic as regards the past, they utter a warning for the future. Any new facility in the Rhone Basin must take account of the existing discharges. Discharge limits cannot be fixed merely by reference to the accepted standards. The modification of the profile of several watercourses in the Basin, especially the increase in the number of dams, indeed introduces new dynamics into the transfer of radionuclides. On the basis of this study of the Basin, power station builders are cautioned, during site selection, against the appearance of a new handicap that seems to assume greater importance with industrial development—the effect of synergism between radioactive, thermal and chemical pollutions. (auth)

29307 RADIOLOGICAL LIMITS AND ENVIRONMENTAL CAPACITIES. Morley, F. (National Radiological Protection Board, Harwell, Eng.). pp 573-581 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

In the last three decades weapons testing and nuclear power programs have added artificially produced radioactive materials to the natural inventory in the environment. Figures for the total activity released are unhelpful in deciding to what extent the environment has been polluted. The most realistic and useful definitions of man-made pollution refer only to those changes that man makes in his environment that are in some way detrimental. The most satisfactory measure of any detriment due to environmental radioactivity is the radiation dose to living tissue. The expression "environmental capacity" is used to mean that if a defined mixture of radionuclides is introduced into a particular sector of the environment over a prolonged period an equilibrium situation will eventually be reached. Practical experience has shown that with rare exceptions the radiation dose to man is the over-riding consideration and the capacity is said to be the rate of release that will result in a dose rate to man equal to some appropriate recommended limit. These dose limits imply a certain degree of risk and the assumed risks inherent in the current limits are examined in the context of the natural radiation background and the natural incidence of cancer and genetically transmitted disease. If the concept of environmental capacity is to be useful quantitatively it must be unambiguously related to dose. The "limiting capacity" is based entirely on the ICRP Dose Limits; the "stipulated capacity," which describes the total of all releases actually approved, includes other factors, social, economic and political, which may have the effect of restricting releases to a level below that of the limiting capacity. (auth)

29308 DEVELOPMENT AND APPLICATION OF THE RADIOLOGICAL CAPACITY CONCEPT IN RADIATION PROTECTION. Amavis, R. (Commission des Communautes Europeenes, Luxemburg); Smeets, J.; Branca, G.; Breuer, F.; Cigna, A. pp 583-592 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The proliferation of nuclear facilities involves an ever larger output of radioactive wastes, a small part of which is discharged to the environment in accordance with regulations laid down by the authorities responsible for the protection of public health and the environment. The presence in these wastes of long-lived radionuclides, and the fact that this contamination extends over an area frequently going beyond national frontiers, have led to the need for strict calculation of the resulting radiation doses to man, particularly in the international context (international rivers and the seas and oceans). The radiological capacity of a hydrobiological basin is a fundamental concept which should be developed and applied to the problem of radiation protection. This makes it necessary to take account of all the processes of transfer and distribution by which the radioactivity reaches man. Examples of the application of the concept confirm its interest for radiological protection. (auth)

29309 OBSERVED VERSUS THEORIZED CAPACITY OF THE ENVIRONMENT FOR RADIOACTIVE CONTAMINANTS. Foster, R. F. (Battelle Pacific Northwest Labs., Richland, WA). pp 593-601 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The potential radiation exposure of people usually establishes the quantity of radionuclides that are acceptable in the environs of nuclear installations. Estimates of the potential doses that may occur are based upon many predictions and assumptions, including the behavior of the radionuclides in ecosystems, the production and harvest of edible products and the dietary, occupational and recreational habits of people. To ensure that radiation doses will not exceed prescribed limits, assumptions used are conservative and the degree of conservatism is inversely related to the confidence associated with an assumption. Because of the conservative nature of the assumptions and other imperfections in the dose calculation process, the radiation exposure actually received by people in the vicinity of an operating nuclear installation may differ substantially from early estimates. Comparisons between predicted and actual doses are possible where radioactive contaminants have been found in readily measurable quantities in the environs of large nuclear complexes (such as the USAEC plutonium plant in the State of Washington) and some nuclear power stations. In most cases the observed concentrations of radionuclides in critical foodstuffs and in people have been substantially less than predicted. The best agreement is with simple, direct exposure pathways such as drinking water. Poor agreement is associated with complex food chains, irregularly consumed foods and short-lived nuclides. Major sources of error are associated with bio-accumulation

factors, market dilution, dietary assumptions and seasonal variations. Conservative assumptions on the capacity of the environment should always be used as a basis for plant design and the setting of effluent standards. However, revised estimates of the dose actually received by people in the environs, and thus the capacity of the environment, should be made as soon as factual data become available. (auth)

29310 RADIOLOGICAL CAPACITY OF THE ENVIRONMENT AS A BASIS FOR FUTURE RADIATION PROTECTION STUDIES. Lacourly, G. (CEN, Fontenay-aux-Roses, France). pp 603-612 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The health hazards arising from the normal effluents discharged by a nuclear facility are evaluated in terms of the irradiation dose to the most exposed population groups. Evaluation of these hazards requires a knowledge of the existing equilibrium relationships between the activity discharged to the environment and the dose to the members of the critical group. Since these relationships are assumed to be known, by assigning a fixed limiting value to the dose one can obtain the maximum activity of the corresponding discharge per unit time. This value is identified with what is called the "limiting radiological capacity of the receiving environment for the radionuclide considered." The limiting radiological capacity depends on a large number of factors associated with the characteristics of the radionuclide, the receiving environment and the populations concerned. It implies that the environment considered is homogeneous and in equilibrium with the radionuclide. The limiting radiological capacity of an environment can be evaluated at three levels: local level, for estimates concerning only a limited population group; regional level, for estimates concerning more extensive contamination (rivers and lakes); and international level, for long-term estimates on the assumption of generalized contamination of the planet (atmosphere and oceans). The relationship between the estimates of discharge and the limiting radiological capacity of the environment considered provides the means of evaluating the level of protection of populations in comparison with the basic standards. (auth)

29311 ENVIRONMENTAL EFFECT OF A COMPLEX NUCLEAR FACILITY. Bebbington, W. P. (E. I. Du Pont de Nemours and Co., Aiken, SC). Chem. Eng. Progr.; 70: No. 3, 85-86(Mar 1974).

The Savannah River Plant (SRP) contains five nuclear reactors, a fuel fabrication facility, a heavy water production plant, and two chemical separations plants constructed and put into operation over the period from 1951 through 1954. The production, management, and release of chemical, radioactive, and thermal effluents from these facilities are discussed. Radiation monitoring activities and results on the site are described. Uses of the site for pulpwood production, as a wildlife refuge, and as an ecological research area are discussed. It is concluded that, after nearly 20 years of diverse nuclear operations, the SRP demonstrates that nuclear technology can be and has been controlled to provide useful services without harmful consequences. (LCL)

29312 SURFACE CONTAMINATION CONTROL AT A PLUTONIUM RESEARCH FACILITY. Enders, J. W. (Los Alamos Scientific Lab., NM). pp 519-537 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Monitoring techniques and operational philosophy used for the control of surface radioactive contamination at the Chemistry and Metallurgical Research Building, Los Alamos Scientific Laboratory, are discussed. A 15-year review of these methods, instrumentation, and record keeping is also presented. (auth)

29313 DEVELOPING PERSPECTIVE CONCERNING CONTAMINATION RELEASES. King, G. E.; Fisher, W. L. (Battelle Pacific Northwest Labs., Richland, WA). AT(45-1)-1830. pp 1257-1265 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

The need and ability to detect and measure radioactive contamination are affected by several factors. Location and magnitude of the contamination, particle size, relative hazard of the isotopes involved, specific activity, and other aspects of the contaminant should be considered, if possible, in evaluating the seriousness of contamination releases. Instrumentation, monitoring techniques, monitoring costs, and personnel relations all are affected by such considerations. Frequently, as much attention is paid to innocuous situations as to those of some radiological significance. The subject of contamination monitoring is discussed with emphasis on the need for placing each contamination release in proper perspective. (auth)

29314 PRINCIPLES OF DERIVED WORKING LIMITS AND INVESTIGATION LEVELS IN RATIONALIZING THE DESIGN AND INTERPRETATION OF MONITORING PROGRAMMES. Dunster, H. J. (United Kingdom Atomic Energy Authority, Harwell, Eng.); Johns, T. F. pp 1743-1754 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Monitoring is usually taken to mean the measurement of radiation or radioactivity for reasons relating to the assessment or control of exposure. It should include methods of interpretation in terms of basic standards. This interpretation is often more difficult than the measurements themselves and can be helped by the use of two concepts, the Derived Working Limit, and Investigation Level. By concentrating attention on the problems of interpretation and on the results of significance in relation to the basic standards, these concepts can also profoundly influence the design of monitoring programmes. These views are developed by examples of current procedures and of proposals for the future. (auth)

Atmosphere

Refer also to abstracts 29780–29782, 29859, and 31358.

29315 (ANL-8078) ENVIRONMENTAL MONITORING AT ARGONNE NATIONAL LABORATORY. Annual Report, 1973. Sedlet, J.; Golchert, N. W.; Duffy, T. L. (Argonne National Lab., Ill. (USA)). Mar 1974. Contract W-31-109-eng-38. 88p. Dep. NTIS $5.45.

The results of the environmental monitoring program at Argonne National Laboratory for 1973 are presented and discussed. To evaluate the effect of Argonne operations on the environment, measurements were made for a variety of radionuclides in air, surface water, Argonne effluent water, soil, grass, benthos, and milk; for a variety of chemical constituents in surface and Argonne effluent water; and of the environmental penetrating radiation dose. Sample collections and measurements were made both on and off the Argonne site for comparison purposes. The results of the program are interpreted in terms of the sources and origin of the radioactive and chemical substances (natural, fallout, Argonne, and other) and are compared with accepted environmental quality standards. (auth)

29316 (BNWL-1850(Pt. 2), pp 51-56) SUSPENDED PARTICLE INTERACTION. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Parameters still experimentally undetermined for airborne effluents are deposition, reentrainment, and leaching characteristics with respect to plant foliage and also the internal translocation patterns of foliarly-deposited plutonium compounds. This work is being undertaken to develop a better understanding of the environmental mobility of plutonium with respect to plant canopies and should produce transfer coefficients of use to health physicists interested in calculating doses to man from airborne plutonium effluents. (auth)

29317 (COO-1340-38) ROLE OF THE GENERAL CIRCULATION OF THE ATMOSPHERE IN RADIOACTIVE DEBRIS TRANSPORT. Technical Progress Report, February 1, 1973–June 30, 1974. Reiter, E. R. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). Mar 1974. Contract AT(11-1)-1340. 28p. Dep. NTIS $4.50.

Work is described which was performed during the period 1 July, 1973 to 30 June 1974, and also the period 1 February 1973 to 30 June 1973 which was covered by an extension of the previous contract period without additional funds. Writing on Part 4 of the "Critical and Creative Review" of Atmospheric Transport Processes proceeded during these two time periods. A visit to the "Physikalisch–Bioklimatische Forschungsstelle Garmisch–Partenkirchen" produced fruitful ideas on the utilization of cosmogenic radionuclides in the age determination of stratospheric air. As in previous years, a Chemist–Meteorologist Workshop in

Fort Lauderdale was again chaired by the principal investigator. The behavior of global circulation patterns in both hemispheres, with special emphasis on stratospheric patterns, has been studied and noteworthy results have been obtained. (auth)

29318 (COO-2222-4) CHARACTERIZATION OF STACK EFFLUENTS FROM CERTAIN NUCLEAR FACILITIES. Final Report, April 1, 1972–June 30, 1973. Matuszek, J. M.; Paperiello, C. J.; Kunz, C. O. (Health Research, Inc., Albany, N. Y. (USA); New York State Dept. of Health, Albany (USA)). 1973. Contract AT(11-1)-2222. 65p. Dep. NTIS $6.25.

Nuclear power reactors produce copious quantities of several species of permanent gas radioactivity, some directly by fission and others by neutron activation of reactor materials and coolants. The gaseous effluents from a boiling-water reactor (BWR), two pressurized light-water reactors (PWR), a high-temperature gas-cooled reactor (HTGR) and a pressurized heavy-water research reactor (PHWR) have been analyzed for radioactive and stable constituents. In the case of the BWR, direct stack sampling has insured representative sampling. The PWRs, HTGR, and PHWR do not provide for direct stack sampling, so analyses of hold-up tank gas, pressure-vessel gas, cover gas, primary-coolant strip-gas, and containment air were required to derive characteristic patterns of gas releases from these reactors. Gamma-emitting gaseous species were measured spectrometrically using a Ge(Li) detector. Chromatographic separation of various gas fractions on a series of molecular sieve columns permitted the use of internal gas-proportional counting tubes for spectrometric resolution of beta-emitting gas species. In addition to measurement of gamma-emitting noble gases, ^{3}H (as hydrogen gas and methane), ^{14}C (as methane and carbon dioxide), ^{37}Ar and ^{39}Ar have been quantitatively identified. Higher hydrocarbon, carbon monoxide, and methyl iodide fractions in the gaseous effluents contained only very low quantities of radioactivity. Estimates are provided of total annual release of the several species, relative release rates as compared to control requirements, and estimates of long-range transport of ^{37}Ar as compared to atmospheric measurements performed by other laboratories. (auth)

29319 (COO-2360-1) EFFECTS OF MESOSCALE WEATHER DISTURBANCES ON CONTAMINATION CONCENTRATIONS. First Technical Progress Report, June 1, 1973–February 28, 1974. Kreitzberg, C. W. (Drexel Univ., Philadelphia, Pa. (USA)). 1974. Contract AT(11-1)-2360. 4p. Dep. NTIS $4.00.

Progress is reported in the development of a mathematical model to be used to dynamically predict the motion and dispersion properties of the atmosphere on the mesoscale which will, in turn, permit calculation of contamination concentrations. (LCL)

29320 (LA-5520-MS) RELATIONSHIP BETWEEN AIR SAMPLING DATA FROM GLOVE BOX WORK AREAS AND INHALATION RISK TO THE WORKER. Gonzales, M.; Ettinger, H. J.; Stafford, R. G.; Breckinridge, C. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-4705-eng-36. 12p. Dep. NTIS $4.00.

A mockup of a plutonium work area was equipped to simulate and monitor aerosol leaks from a glove box into the worker's environment. Dioctyl phthalate was the tracer aerosol used, and aerosol concentration throughout the work area was monitored under several different ventilating conditions. Aerosol concentration in the worker's breathing zone was up to 250 times greater than the concentrations that might be indicated by typical fixed room-air samplers located adjacent to the glove box. The effect on the magnitude and pattern of aerosol dispersal was evaluated in light of ventilation rate and direction of the ventilating air flow relative to the leak. (auth)

29321 (LA-UR-73-1004) PROBABILISTIC EVALUATION OF FALLOUT EFFECTS ASSOCIATED WITH NUCLEAR AIR BURSTS. Fultyn, R. V. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 18p. (CONF-740112-1). Dep. NTIS $3.00.

From winter simulation conference; Washington, District of Columbia, USA (14 Jan 1974).

Several effects of fallout from air bursts of small and nominal yield nuclear weapons under circumstances which include probability of precipitation are modeled. Calculations of the distributions of the effects, and evaluations of the probability of exceeding given values of the effects, are included. The model incorporates inherent uncertainties about meteorological conditions and the stochastic nature of mass transport phenomena under turbulent conditions. Effects measurements from tests of weapons suspended from balloons over Nevada have been used to evaluate input parameters and demonstrate the accuracy of prediction of the model under dry circumstances. (auth)

29322 (NERC-LV-539-17) OFF-SITE SURVEILLANCE ACTIVITIES OF THE NATIONAL ENVIRONMENTAL RESEARCH CENTER FROM JULY THROUGH DECEMBER 1970. (National Environmental Research Center, Las Vegas, Nev. (USA)). Feb 1974. Contract AT(26-1)-539. 153p. Dep. NTIS $5.45.

During the period July through December 1970, six announced underground nuclear tests were conducted at the Nevada Test Site (NTS) by the Atomic Energy Commission. During this same period, four production test experimental flarings of natural gas were conducted at the Rulison experimental gas well in western Colorado. One test at the NTS, Baneberry, conducted on December 18, released radioactivity into the off-site environment. At the Rulison site, ^{3}H and ^{85}Kr above background levels were detected off-site. From the results of environmental monitoring and sampling conducted by the National Environmental Research Center, Las Vegas (NERC-LV) for these nuclear events, the calculated radiation exposures to off-site populations did not exceed the Radiation Protection Standards of the AEC Manual, Chapter 0524. The maximum level of ^{3}H in air samples collected off-site by a ground level air sampling station for Project Rulison was 290 pCi/m^3 air, which is less than 0.5% of the Concentration Guide in the AEC Manual 0524 for a suitable population sample in an uncontrolled area. No ^{3}H levels above background were found off-site in milk, water, food crop, cow feed, human urine, and animal tissue samples collected following the flarings. The highest estimated infinity external gamma exposure at an inhabited location following Baneberry was 16 mR at Blue Jay Highway Maintenance Station, 66 miles northeast of Tonopah, Nevada, on Highway 6. The maximum estimated thyroid dose from the ingestion of milk following Baneberry was 130 mrem to a two-year-old child, residing in Beatty, Nevada, who was drinking milk produced at the McCurdy Ranch near Springdale, Nevada. The highest estimated dose to a hypothetical 2-gram infant thyroid was 260 mrem from milk produced at the McCurdy Ranch. Eight sheepherders working between Eureka and Duckwater, Nevada, were using Baneberry contaminated melted snow for domestic purposes. The estimated thyroid dose to the herders from consuming melted snow was 0.5 rem ± a factor of 3, i.e., 0.17 to 1.5 rem. The maximum estimated inhalation dose to a hypothetical infant thyroid from radioiodines in air was 100 mrem at the Stone Cabin Ranch near Highway 6, between Tonopah and Warm Springs, Nevada. (auth)

29323 (NP-19938, pp vp, Paper 2) DIFFUSION OF FISSION PRODUCTS IN THE AIR. Klug, W. (Technischen Hochschule Darmstadt, Ger.). Nov 1971. (In German).

The diffusion of fission products in the air is calculated from the theory of turbulent diffusion in the atmosphere using the Pasquil diffusion types. (JSR)

29324 (NP-19938, pp vp, Paper 3) MASS AND PROPERTIES OF FISSION PRODUCTS RELEASED IN NUCLEAR EXPLOSIONS. Ruehle, H. (Bundesgesundheitsamtes, Berlin). Nov 1971. (In German).

The fission product mixture released in nuclear warfare research is discussed and the β activity of the atmosphere is evaluated as a function of age. The maximum permissible concentrations of fission product mixtures are evaluated. The types of fallout can be divided into local, tropospheric, and stratospheric. The characteristics of each of these types are briefly outlined. (JSR)

29325 (NVO-410-22) ENVIRONMENTAL RADIOACTIVITY AT THE NEVADA TEST SITE, JULY 1967 THROUGH JUNE 1968. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nev. (USA). Environmental Sciences Dept.). Jul 1969. Contract AT(26-1)-410. 89p. Dep. NTIS $5.45.

Data obtained from periodic environmental surveys at the Nevada Test Site (NTS) from July, 1967 through June, 1968 are summarized. The Environmental Surveillance group performed routine and special surveys of the NTS. Samples of potable water were collected for laboratory analysis from living quarters, administrative facilities, and cafeterias. Additionally, samples of water from waste ponds, sewage basins, reservoirs, springs, and wells were collected on a routine basis to determine ambient levels of radioactivity or any changes of radioactivity. Air samples were also routinely collected at selected locations throughout NTS for the same purpose as for water samples. Soil and vegetation samples were collected to provide information for assessing trends in the distribution of fallout radioactivity levels. All environmental samples, except soil and vegetation, were analyzed routinely for gross beta radioactivity, and selected samples were additionally analyzed for plutonium alpha activity. Soil and vegetation samples were routinely analyzed for gross gamma radioactivity. Significant increases or changes in the radioactivity levels of these samples were reported to the appropriate field monitoring groups for investigation and remedial action. All sample results are permanently maintained by the Environmental Surveillance group for record purposes and for comparison with previous results to determine trends and correlations where feasible. (auth)

29326 (ORO-2529-41) ATMOSPHERIC RADIOCHEMISTRY. Annual Progress Report. Kuroda, P. K. (Arkansas Univ., Fayetteville (USA). Dept. of Chemistry). 30 Apr 1974. Contract AT(40-1)-2529. 118p. Dep. NTIS $9.00.

Results obtained during the period from May 1973 to May 1974 in atmospheric radiochemistry research projects are reported. These projects studied: the behavior of ^{90}Sr in rain and air after the n...th Chinese nuclear explosion; cerium isotopes in fallout from Chinese and French nuclear weapons tests; global transport of fallout from nuclear weapons testing; fallout from recent Chinese nuclear explosions; residence time of ^{90}Sr in the atmosphere; variation of the $^{137}Cs/^{90}Sr$ ratio in the atmosphere; mean residence times of long-lived radon daughters in the atmosphere; ratio of fission product pairs with similar half-lives in the atmosphere; ^{90}Sr content in rain samples collected in Arkansas, Turkey, and Japan following 14th Chinese nuclear explosion; and ^{137}Cs, ^{90}Sr, and $^{137}Cs/^{90}Sr$ ratios in rainwater collected at Fayetteville, Arkansas during June 1967 through June 1969. (LCL)

29327 (ORO-3944-7) STUDY OF TRITIATED HYDROGEN AND ITS COMPOUNDS IN THE ENVIRONMENT. Progress Report, July 1, 1973–March 31, 1974. Oestlund, H. G. (Miami Univ., Fla. (USA). Rosenstiel School of Marine and Atmospheric Sciences). 1974. Contract AT(40-1)-3944. 24p. Dep. NTIS $4.25.

It can now be considered proven that tritium gas (HT or T_2 or DT) leaks from underground thermonuclear explosions to the troposphere. Large peaks in the HT levels have been detected at our ground-level stations at times which are compatible with the large USSR underground tests and the global circulation pattern. The WB-57F sampler for HTO and HT has finally been flown two times and functioned properly both times. The preliminary results indicate no increase in HT between the tropopause and 60,000 feet. (auth)

29328 (PNE-WW-34) ENVIRONMENTAL MONITORING REPORT, PERIOD COVERING AUGUST 1, 1973 THRU DECEMBER 8, 1973 FOR EL PASO NATURAL GAS COMPANY: PROJECT WAGON WHEEL. (Eberline Instrument Corp., Santa Fe, N. Mex. (USA)). [nd]. 26p. Dep. NTIS $4.50.

Results from the Radiation Monitoring Program conducted during August to December 1973 for Project Wagon Wheel are presented. Beta radioactivity in air particulates ranged from 0.02 to 0.05 pCi/m^3. These levels are consistent with those for the previous quarters and indicate lower levels of worldwide fallout. Concentrations of gamma emitters were too low to measure by NaI(Tl) gamma spectrometry. TLD data for the period of July 6, 1973 to December 3, 1973 averaged 2.3 mrem/week. This is within the range of other measurements made at this site since 1971. Gross beta measurements in surface, municipal, and well water ranged from less than 2 to 7.6 pCi/l. Gross beta in precipitation was 0.4 ± 0.1 nCi/m^2. The tritium concentration in airborne moisture, surface water, municipal, and well water was less than 1 pCi/ml by liquid scintillation counting. Surface and well water tritium content measured by gas counting averaged 0.7 pCi/ml with the highest level being 1.4 pCi/ml for Meadow Lake. The concentrations of ^{90}Sr in vegetation ranged from 0.1 to 0.4 pCi/g (dry weight). The tritium concentrations in water recovered by distillation was less than 1 pCi/ml. No gamma emitters other than natural potassium were detected. The tritium concentration in water recovered by distillation from animals and fish was less than 1 pCi/ml. No gamma emitters other than potassium were detected. The concentration of ^{90}Sr in milk ranged from 2.5 to 12.4 pCi/l. The concentration of tritium measured was less than 1 pCi/ml. No gamma emitters other than natural ^{40}K were detected. The concentration of tritium in urine was less than 2 pCi/ml. None of the results obtained during the period differed significantly from expected levels. (auth)

29329 (SSI-1974-9) ANNUAL REPORT TO THE SWEDISH ATOMIC RESEARCH COUNCIL 1973. Lindell, B.; Snihs, J. O.; Swedjemark, G. A.; Bengtsson, G. (Statens Seruminstitut, Copenhagen (Denmark)). Jan 1974. 18p. (In Swedish). Dep. NTIS (U.S. Sales Only) $4.00.

The scientific work at the Department of Nuclear Physics, the Special Laboratories and the Dosimeter Laboratory is described. Investigations were done concerning natural radioactivity in mines (especially radon and its daughter products), in buildings, and in drinking water. The amounts of radioactive substances, natural radioactivity and fallout, were measured in different foods. Metabolism of radioactive substances was studied. Finally a survey is given of the different measuring techniques. (SW)

29330 (STI/DOC-10-147) ENVIRONMENTAL ISOTOPE DATA NO. 4: WORLD SURVEY OF ISOTOPE CONCENTRATION IN PRECIPITATION (1968–1969). (International Atomic Energy Agency, Vienna (Austria)). 1973. 347p. IAEA $8.00.

Tabulated data are presented on the tritium, deuterium, and ^{18}O content in monthly samples of precipitation collected at 177 world-wide stations during 1968 and 1969. Data from 1963 to 1968 which did not appear in previously published issues are included as late reports. (LCL)

29331 (UCRL-51530) RAINOUT STUDIES AT LAWRENCE LIVERMORE LABORATORY. Knox, J. B.; Williams, A. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Feb 1974. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

The study of rainout has received additional impetus from recent investigations of the impact of collateral damage upon tactical nuclear operations. Additional research is going forward at Lawrence Livermore Laboratory to provide an improved technical basis for the assessment of rainout. The project is designed to develop improved understanding of the basic physical interactions that control the processes and to assess more rigorously the potential hazards to man. Aspects of the work described here include a microphysical description of precipitation scavenging of the nuclear debris aerosol, progress in the numerical modeling of natural cloud systems and their interactions with nuclear debris aerosols, and investigations of possible means of controlling the rainout-removal process. This is an interim report; it is expected that continuing research over the next six months will permit a more precise basis for analysis of the phenomenon. (auth)

29332 (UCRL-51547) ENVIRONMENTAL LEVELS OF RADIOACTIVITY IN THE VICINITY OF THE LAWRENCE LIVERMORE LABORATORY. 1973 Annual Report. Silver, W. J.; Lindeken, C. L.; Meadows, J. W.; Hutchin, W. H.; McIntyre, D. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Mar 1974. 49p. Dep. NTIS $4.00.

The Lawrence Livermore Laboratory continuously monitors the levels of radioactivity within the Livermore Valley and Site 300. Results of analyses performed during 1973 for gross radioactivity and for specific radionuclides of interest in a variety of environmental samples are presented. In all cases, the levels of activity observed during 1973 were found to be below the appropriate concentration guide values in AEC Manual Chapter 0524. Particulate air filters showed gross beta activities lower than those observed during 1972, reflecting a reduction in global fallout in the atmosphere. Gamma spectral measurements on Laboratory perimeter air filters also showed lower activities of global fallout gamma emitters. These perimeter air samples were analyzed for ^{239}Pu, ^{238}Pu, ^{90}Sr, ^{235}U, and ^{238}U. With the exception of one sampling location, the annual average ^{239}Pu concentration was 1.3×10^{-17} $\mu Ci/ml$, typical of global fallout. Air samples taken within Site 300 were analyzed for uranium. These analyses showed a lower than normal ratio of $^{235}U/^{238}U$. This is due to "depleted" uranium (uranium which is specially processed to lower the ^{235}U content) used at the Site. Airborne uranium concentrations were well below the standards set by the AEC. Soil samples collected in the off-site vicinity of LLL perimeter boundaries and at Site 300 were analyzed for plutonium, uranium, and gamma emitting radionuclides. Traces of plutonium above global background levels were detected in two off-site samples near the east perimeter of the Laboratory. Sediment samples collected in surface drainage pathways from LLL showed that the plutonium in these sediments was in the same range observed in soil samples collected in the Livermore Valley. Site 300 soil samples indicate depleted levels of ^{235}U near firing bunkers, but $^{235}U/^{238}U$ ratios approach that of natural uranium at site perimeters. These data indicate no apparent change from that observed in 1972. Water samples collected within the Livermore Valley exhibited normal background gross beta and tritium activities. Gamma spectral analyses of vegetation samples revealed no gamma-emitting radionuclides other than those present naturally or in global fallout. The vegetation samples collected in areas generally downwind from the Livermore Laboratory revealed tritium activities 10 to 100 times higher than those collected in areas where the Laboratory's contribution should be minimal. However, if the vegetation were a regular part of one's diet, the annual whole body radiation dose from tritium would be less than 1 mrem. The off-site radiation exposure rates measured by thermoluminescent dosimeters were in the range to be expected from the naturally occurring radionuclides in the soil and from local cosmic radiation. Assessment of the radiation doses to an individual from the observed environmental activities listed indicates the contribution from artificially produced radionuclides is small in comparison with the approximately 100 mrem/y dose received from natural sources. (auth)

29333 (UCRL-75484) RESUSPENSION OF PLUTONIUM: A PROGRESS REPORT. Anspaugh, L. R.; Phelps, P. L.; Kennedy, N. C.; Booth, H. G.; Goluba, R. W.; Reichman, J. R.; Koval,

J. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1974. 62p. Dep. NTIS $5.25.

Progress is reported for a research program on the resuspension in the atmosphere of plutonium fallout deposited on the earth surface. The long-range goal of the resuspension studies is to produce a set of equations which can be used to predict the time-dependent average concentration of resuspended material downwind from a source of any geometrical configuration and soil surface characteristics. The experiments are conducted at the Nevada Test Site where plutonium-high explosive tests were performed during the period from 1954 to early 1956. The investigations have included: monitoring of soil samples for Pu; development of ultra-high volume air samplers, in-situ particle spectrometers, particle counters, and a micrometeorology field laboratory; determination of Pu redistribution due to the rolling of soil particles pushed by winds (creep), the bouncing of wind-pushed particles (saltation), and transport by dust devils; and measurements of meteorological parameters. Results from these experiments will be used to establish a data bank on radioisotope distribution and meteorological conditions at NTS and to provide information of the relation between the source and the dose to man from existing radioactivity. (LCL)

29334 WIND-DRIVEN REDISTRIBUTION OF SURFACE-DEPOSITED RADIOACTIVITY. Anspaugh, L. R. (Univ. of California, Livermore); Phelps, P. L.; Kennedy, N. C.; Booth, H. G. pp 167-184 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The deposition of radionuclides on a terrestrial surface can result in the delivery of dose to man through external radiation exposure, food chain contamination or inhalation of suspended particles. ^{239}Pu is one of the few radionuclides generally regarded as constituting an inhalation hazard through wind-driven resuspension. No adequate models of resuspension exist. Two major problem areas have been identified: the rate at which initially deposited debris weathers into a less erodible state as a function of time, and a source term factor in material removed per unit time per unit area, applicable to a source of any configuration. In experiments conducted at the US Atomic Energy Commission's Nevada Test Site, concentrations in air of particles moving in suspension were studied over a period of six weeks following the nuclear cratering event Project Schooner and over a 10-month period following accidental venting of an underground nuclear explosion. Suspended air activity was observed to decrease in time with half-times of from 35 to 80 days; this factor appears to be much more important than variations in meterological parameters over these relatively short time periods. Movement of small particles in suspension accounts for only a minor fraction of the total mass movement. As much as 50% of the initially deposited debris was moved by saltation within a 24-hour period. Such movement can result in extensive micro-inhomogeneities with accumulation of debris under bushes or other places affording shelter from erosive forces. More detailed study of the resuspension process in an aged ^{239}Pu field is now in progress. Preliminary data are given on the particle size distribution of the total mass and the ^{239}Pu moving in suspension. (auth)

29335 EVALUATION OF RADIOACTIVE AND NON-RADIOACTIVE TRACE CONSTITUENTS EMITTED FROM FOSSIL-FUEL AND NUCLEAR POWER PLANTS. Jordan, S.; Schikarski, W. (Kernforschungszentrum, Karlsruhe, Ger.). pp 525-535 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

On the basis of a simplified box model the relative body burden function S = K/MPC for the pollutants released in major quantities from fossil-fuel and nuclear power plants has been calculated and compared. Besides these main pollutants (SO_2, NO_2, ^{133}Xe, ^{85}Kr), other substances are released but in smaller quantities. Since some of these substances (for example: Ra, Hg, ^{3}H, etc.) are toxicologically important, the environmental effects are not negligible. Using a further developed box model that takes into consideration the vertical distribution of pollutants and the behavior of the pollutants in the atmosphere body burden functions of high toxic trace constituents released from coal, oil and gas-fired and nuclear power plants are calculated. The trace constituents are: radium, fluorine, cacmium, mercury from fossil-fuel power plants and ^{131m}Xe, ^{3}H, and ^{131}I from nuclear power plants. The body burden functions are compared with those of the major pollutants. It is found that the environmental effects of radium from coal-fired power plants are small compared with the environmental effects of radioactive materials released from nuclear stations. Other trace pollutants, for example fluorine compounds, provide a larger contribution to the integral body burden. The relative importance of the various trace constituents released from power stations is discussed. (auth)

29336 PRELIMINARY EXPERIENCE GAINED IN MONITORING KRYPTON-85 RECEIVED IN THE NEIGHBORHOOD OF KARLSRUHE REPROCESSING PLANT. Fessler, H.; Koenig, L. A.; Nester, K.; Winter, M. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). pp 663-672 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

Several 100 Ci of krypton-85 activity are released from a Purex-type plant for spent nuclear fuel operated in the direct neighborhood of the Karlsruhe Nuclear Research Center at 60 m height after each dissolving process of an average duration of six hours. To evaluate the burden on the environment, air samples are taken with a compressor at two places in the forecasted area of maximum concentration received. The samples are taken shortly after the emission maximum has been attained. Prior to measurement in a gas-filled counter tube, the krypton is separated into two enrichment steps, utilizing adsorption to cooled activated charcoal. When 1 m^3 of sampled air is measured for over 100 min, a detection limit of 4 pCi/m^3 is obtained. In measurements performed in connection with fuel element dissolving concentrations were found that exceeded the present ^{85}Kr background of about 20 pCi/m^3 by up to a factor of 5000. For such measurements 100 liters of sampled air are sufficient, the processing of which takes several hours. The krypton concentrations measured are compared with concentration values on the basis of the meteorological conditions prevailing during sampling and the relevant Pasquill diffusion parameters, taking into account the sampling time. An estimate of the uncertainties in the definition of the diffusion parameters required for the calculation allows a better understanding of the partly significant differences between experimentally determined and calculated concentration values. Taking the available results of concentration measurements and of the total emission per dissolving process as a basis, the maximum local β-dose to the environment can be assessed in a more realistic way. This is of particular interest since the β-dose values per dissolving step are below dosemeter detection limits. (auth)

29337 AIR SAMPLING IN OPERATIONAL MONITORING. Schulte, H. F. (Los Alamos Scientific Lab., NM). pp 1007-1027 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

Air sampling is a necessary part of an operational monitoring program when large quantities of radioactive materials are handled. While general principles and techniques of sampling can be set forth, the details of the system must be related to the specific needs and limitations of a particular facility. The purposes of air sampling must be clearly defined and the system designed to meet these purposes. Air sampling requirements to define the environment for better control purposes may be quite different from those required for the estimation of individual radiation dosages. Where there is a limitation of how much sampling can be carried out and evaluated, the need for data for control purposes should prevail. Merely increasing the number of samples collected does not solve all problems. Increasing use is being made of multistage samplers, personal samplers, and various automatic sampling devices. These are reviewed and discussed. Use of statistical methods, new sampling devices and the activities of the numerous committees and agencies in this field are discussed. (auth)

29338 RADIOACTIVITY AIR MONITORING IN MEXICO. Skertchly, M. B.; Nulman, R. M.; Vasquez, M. B. (Comision Nacional De Energia Nuclear, Piso, Mexico). pp 1171-1184 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

The program used for monitoring air for radioactivity in Mexico is described. It was designed to fit the following local

conditions: Geographical and meteorological conditions have prevented the country from receiving considerable contamination from nuclear debris. Almost all activities being detected are transported to the earth's surface from the stratosphere, where they were previously injected, therefore ^{89}Sr and ^{131}I are not measured. There is no point source of contamination, since no large reactors or fuel reprocessing plants are in operation in Mexico. Sampling must detect any dangerous increase in activity in any part of the territory, give a general idea of the exposure of the population, and yet it must be inexpensive. To satisfy these conditions, isograms are made of gross β activity. Radiochemical analyses are only made when gross β activities are higher than $1/10$ of M. P. C. Since the personnel are not trained in operating counting equipment, samples are returned to the laboratory for counting. (auth)

29339 INFLUENCE OF SOME GEOPHYSICAL FACTORS ON GAMMA BACKGROUND AND ^{222}Rn CONCENTRATION IN SOIL AND ATMOSPHERE. Pensko, J.; Wardaszko, T.; Wochna, M. (Central Lab. for Radiological Protection, Warsaw). G. Fis. Sanit. Prot. Radiaz.; 16: No. 4, 157-167(1972).

Observations were carried out on dependence of natural gamma radiation background and ^{222}Rn concentration on various environmental condition factors. Differences between daily mean values of radon exhalation from soil greater than one order of magnitude were noticed, which can not be explained on the basis of the instability of diffusion factor. These differences are probably caused by variation of water or ice content in the soil influencing the mechanism of radon diffusion. From observation of soil freezing effects on radon exhalation it may be supposed that the radon diffusion factor in ice is considerably greater than in water. In the period of soil water freezing the vertical distribution on radon concentration is quite different from that in normal conditions. (auth)

Soil

Refer also to abstract 29174.

29340 (BNWL-1812) CHARACTERIZATION OF ACTINIDE BEARING SOILS: TOP SIXTY CENTIMETERS OF 216-Z-9 ENCLOSED TRENCH. Ames, L. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1974. Contract AT(45-1)-2130. 142p. Dep. NTIS $5.45.

A program to examine the soil-actinide relationship in sediments from a disposal facility was initiated in March 1973. Initial work has been done using samples from the 216-Z-9 covered trench. Soil mounts were made of soil recovered from a core of an uncontaminated well drilled alongside Z-9 trench. The mounts were made by plastic-impregnating smaller, 1-in. diameter cores taken from the original 4-in. diameter cores. The uncontaminated mounts showed that the less than 30 mesh soil was composed of predominately metamorphic rock fragments of the Belt Series, brought down from northern Washington and Idaho by the ancestral Columbia River. Two 4-in. diameter cores, 2 ft in length, were taken from the floor of Z-9 trench. Smaller contaminated mounts were made from these original cores in the same manner as with the uncontaminated samples. Overlying one of these cores (4-11), was a sludge layer of silica, alumina and water. The other core (4-5) had no sludge layer. At least two types of plutonium were found in cores 4-11 and 4-5 by autoradiographic and microprobe examination. The plutonium particles (up to 10 μm in diameter and 60 wt % PuO_2) were the most conspicuous form. These occurred near the top of the core 4-11, but extended down nearly to the bottom of core 4-5. It is probable that the sludge layer over core 4-11 acted as a filtering media to remove and concentrate the plutonium particles. The second form of plutonium occurred in lesser concentration (<0.4 wt % PuO_2) but was found throughout the lengths of both cores associated with silicate hydrolysis. Silicate hydrolysis was investigated with microprobe chemical analysis. Loss of alkalies and alkaline earths, along with the absence of several metamorphic minerals found in the uncontaminated mounts, indicated extensive chemical attack of soil rock fragments by acidic influent solutions. The locations of the base of the silicate hydrolysis zone, and associated plutonium deposition, are presently unknown. (auth)

29341 (BNWL-1850(Pt. 2), pp 25-34) CHARACTERISTICS OF HANFORD SOILS AND AQUATIC SEDIMENTS. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Soils investigations have been directed largely toward delineation of the role of arid soils in carbon and nutrient cycling as influenced by environmental perturbations. Until this year, primary emphasis in these studies was on the ALE Reserve. However, recently these investigations have been extended to emcompass the fate of radionuclides in a broad range of surface soils. In aquatic sediment studies, investigations have been directed toward measurement of the physiochemical properties of suspended matter and sediments of the lower Columbia River watershed and mercury form and distribution in these components as these may be influenced by seasonal changes in watershed and river conditions. (auth)

29342 (LA-5483-MS) PROPOSED INTERIM STANDARD FOR PLUTONIUM IN SOILS. Healy, J. W. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1974. Contract W-7405-eng-36. 100p. Dep. NTIS $4.00.

Current standards for controlling health effects from plutonium in the body are discussed. Available information on possible sources of exposure of people living in an area where the soils are contaminated with plutonium is analyzed to arrive at estimates of intake. From these estimates, a recommended interim standard for the upper limit of concentration of plutonium in the soils in inhabited areas is derived. The recommendation is based upon conservative assumptions where information is lacking and further studies should result in revision. The subjects of resuspension, deposition velocity of particles, and effectiveness of radioactive particulates in producing lung cancer are discussed in appendices. (auth)

29343 (SLA-74-167) ENVIRONMENTAL MONITORING REPORT FOR SANDIA LABORATORIES FOR 1973. Brewer, L. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1974. Contract AT(29-1)-789. 21p. Dep. NTIS $4.25.

Water, soil, and vegetation are regularly monitored by several different methods and the results analyzed to assure that Sandia Laboratories operations are not adversely affecting the surrounding environment. The radiation levels are presented for the year 1973. (auth)

29344 TRANSPORT OF ^{131}I, ^{137}Cs, ^{106}Ru, ^{144}Ce, AND ^{54}Mn IN AN UNDISTURBED SOIL UNDER NATURAL ENVIRONMENT CONDITIONS. Kuehn, W.; Handl, J.; Schaetzler, H. P. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich). pp 347-362 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

An unusually large, undisturbed and overgrown soil sample with a diameter of 1.9 m and a height of 1.5 m was taken from a site assigned for a reactor. Over a long period of time the translocation of a mixture of fission products, containing ^{131}I, ^{137}Cs, ^{106}Ru, ^{144}Ce and ^{54}Mn was investigated in the soil sample under natural atmospheric conditions. The surface activity corresponded to an accident situation that might occur when activity is released through the chimney. The penetration of the radionuclides into the soil was determined by γ-spectroscopy and autoradiography. For 10 months after the contamination the fission products, mainly cationic, could only be found in the superficial soil layers. Additional investigations with ^{131}I and inactive iodine, determined by activation analysis, showed that anionic iodine penetrates deeper into the soil within a shorter period of time than do cations. This offers the possibility of determining in advance the extent of a casual iodine contamination by investigations with inactive iodine in a specific soil. (auth)

29345 RADIOIODINE TRANSFER IN AN IRRIGATED GRASSLAND ECOSYSTEM (MARCITA). de Bortoli, M.; Gaglione, P.; Myttenaere, C. (EURATOM, Ispra, Italy). G. Fis. Sanit. Prot. Radiaz.; 16: No. 4, 184-190(1972).

Research was conducted to obtain information on the contamination of herbage in irrigated grasslands by ^{131}I present in irrigation water. The experiment has been carried out on a model in the laboratory, which was contaminated with ^{131}I. The radionuclide has been determined at different times in water, grass, and soil and thus data have been obtained in terms of concentration as well as of activity budget. These data indicate that, in the conditions of the experiment: the water-grass transfer coefficient is about 0.08 μCi/g grass per μCi/cm^3 water; the activity distribution within the plant is roughly in the proportion: roots = 100, stembases = 40, shoots = 2; and the vertical profile of the activity in the soil is approximately exponential, the concentration in the upper 3 cm layer being one order of magnitude higher than that of the shoots. Finally, a derived working limit for ^{131}I in irrigation water, which was the main goal of the work was obtained. This limit, namely 3×10^{-5} μCi/cm^3, corresponds to the dose limit for 6-month-old child fed with the milk produced with the contaminated herbage. (auth)

Water

Refer also to abstracts 29399 and 30186.

29346 (BNWL-1754) MODELS AND COMPUTER CODES FOR EVALUATING ENVIRONMENTAL RADIATION DOSES. Soldat, J. K.; Robinson, N. M.; Baker, D. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1974. Contract AT(45-1)-1830. 170p. Dep. NTIS $7.60.

Prior to the issuance of construction permits or operating licenses for nuclear power reactors, the U. S. Atomic Energy Commission is required by the National Environmental Policy Act of 1969 to prepare Detailed Environmental Impact Statements. These statements contain analyses of the balance between benefits and costs of the proposed action, including the radiological impact of operation of the facility. Methods for computing environmental radiation doses are described. A simplified model for calculation of radiation doses from radioactive effluents was developed and programmed into a conversational language, providing the fast turnaround time required. The new model is divided into four independent parts, each written as a separate program: ARRRG: calculates individual and population doses from liquid effluents; CRITR: calculates internal radiation doses to four common classes of aquatic organisms and to organisms which consume them; FOOD: calculates doses from consumption of food crops and animal products produced on irrigated farms; and GRONK: calculates doses from gaseous effluents, to individuals and to the total population within 50 miles. The model can be used to calculate radiation doses to the total body and selected organs of individuals and population groups, and to organisms other than man. It includes all air and liquid exposure pathways thought to be significant and for which a reasonable amount of supporting data is available. Internal doses to man are based on a 1-year radionuclide intake, assuming no prior accumulation in the body. The radionuclide content of ingested food is assumed to be at equilibrium with the environment. This paper discusses the models in detail and describes the programs ARRRG, CRITR and GRONK; the program FOOD is still being developed and is not included in this report. (CH)

29347 (BNWL-1850(Pt. 2), pp 84-100) FACTORS AFFECTING BIOGEOCHEMICAL CYCLING. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

The main objectives of these studies are to define the present and time-dependent inventory of various radionuclides in the Columbia River-McNary Reservoir ecosystem and other aquatic ecosystems receiving radioactive wastes. Of primary interest is the determination of their rates of exchange, and the chemical, physical, and biological mechanisms that are important in the cycling of these materials in the aquatic food-webs. The ultimate goal of the studies is to develop mathematical models to predict the cycling processes and to describe the rates and mechanisms involved in the various chemical, physical, and biological parameters that govern the cycling of radionuclides in these ecosystems. (auth)

29348 (BNWL-1850(Pt. 2), pp 101-104) BIOENVIRONMENTAL EFFECTS OF EFFLUENTS DISCHARGE FROM NUCLEAR POWER PLANTS TO COASTAL WATERS. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Research on the thermal resistance of marine organisms is reported. Studies during the year concentrated on the exposure of embryonic and juvenile life stages of animals and on the interaction of temperature change and differing salinity. Data are presented on the effects of rate of temperature increase plus maximum temperature and the effects of salinity plus temperature on the mortality of rock sole eggs and the Critical Thermal Maxima for coon stripe shrimp and some common Pacific Northwest species. (LCL)

29349 (BNWL-1850(Pt. 2), pp 108-115) PHYSICAL AND RADIOLOGICAL CHEMISTRY OF OCEAN SOLUTIONS. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Data are presented on: the ^{60}Co distribution in sediments along the Washington Pacific Ocean shoreline; temporal variations in the ^{7}Be concentrations in world oceans; latitudinal variations in ^{7}Be concentrations in surface waters of the Eastern South Pacific Ocean; ^{238}Pu and ^{239}Pu content in seawater samples from the South Pacific and Atlantic Oceans; and trace elements content in liver tissues from Antarctic seals and penguins. (LCL)

29350 (BNWL-1850(Pt.2), pp 116-120) GEOCHEMICAL OCEAN STUDY SECTION. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Data are presented on the: mercury distribution in the Western Atlantic Ocean based on analyses of GEOSECS seawater samples; trace element distribution in the Western Atlantic Ocean based on neutron activation analysis of GEOSECS seawater samples; and ^{7}Be and fallout radionuclide monitoring of Pacific Ocean during GEOSECS expedition. (LCL)

29351 (NP-19938) RADIOACTIVE MATERIALS AND DRINKING WATER SUPPLY IN A NUCLEAR CATASTROPHE. (Bundesministerium des Innern, Bonn (F. R. Germany)). Nov 1971. 550p. (In German). Dep. NTIS (U. S. Sales Only) $29.50.

Fourteen reports from West German research on the effects of a nuclear catastrophe on the drinking water supply are presented. A separate abstract was prepared for each paper. (LCL)

For abstracts of individual papers see: 29137, 29323, 29324, 29352–29358, 29398, 29443, 29754, and 31358.

29352 (NP-19938, pp vp, Summ.) RADIOACTIVE MATERIALS AND DRINKING WATER SUPPLY IN A NUCLEAR CATASTROPHE: SUMMARY REPORT OF THE WATER CONTAMINATION TASK GROUP. Nov 1971. (In German).

In 1966 the Minister for Sanitary Affairs established a committee to investigate the effects of a nuclear catastrophe on the drinking water supply. The fields of physics, chemistry, meteorology, geology, hydrology, water technology, medicine, and radiation biology were represented in the study. A summary of the report of this committee is presented. The report summarizes the present status of drinking water in West Germany, the release and propagation of radioactive materials in a nuclear explosion near the ground, release and propagation of radioactive material from extreme incidents in nuclear power plants, behavior of radioactive material in various types of water occurrences, estimation of the contamination to be expected in various water occurrences as the result of a nuclear catastrophe, radiation effects on the population from contaminated drinking water, necessity and possibilities of monitoring contamination of water, and necessity of precautions and the types available. (JSR)

29353 (NP-19938, pp vp, Paper 5) CONTAMINATION OF PRECIPITATION AND WELL WATER AS A RESULT OF NUCLEAR WARFARE RESEARCH. Aurand, K.; Ruehle, H. (Bundesgesundheitsamtes, Berlin). Nov 1971. (In German).

The total β activity and the ^{90}Sr concentration in precipitations and well water measured in the German Federal Republic from 1956 to 1969 are tabulated and graphed. (JSR)

29354 (NP-19938, pp vp, Paper 6) CONTAMINATION OF RUNNING WATER FROM FALLOUT IN EXTREME REACTOR INCIDENTS. Jacobi, W.; Stolterfoht, N. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nov 1971. (In German).

The contamination of surface waters to be expected from the fallout in extreme reactor accidents and the resulting dangers to the population from the use of these waters for drinking are evaluated. The release of diffusion of fission products from an extreme accident is evaluated from the type of reactor accident. The contamination of running water through direct fallout on the water surface and by fallout at the water source is calculated. (JSR)

29355 (NP-19938, pp vp, Paper 7) ESTIMATION OF THE CONTAMINATION OF SURFACE WATER BY FALLOUT FROM NUCLEAR EXPLOSIONS. Jacobi, W.; Stolterfoht, N. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nov 1971. (In German).

The contamination of surface waters to be expected from the fallout from near-ground nuclear explosions in the Mt range is evaluated. The principles and methods used in the evaluation are outlined. The values obtained are shown graphically. The significance of the results for the drinking water supply is discussed. (JSR)

29356 (NP-19938, pp vp, Paper 8) EVALUATION OF THE CONTAMINATION OF DRINKING WATER RESERVOIRS BY FALLOUT FROM NUCLEAR EXPLOSIONS AND EXTREME REACTOR INCIDENTS. Jacobi, W.; Stolterfoht, N.; Haberer, K. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nov 1971. (In German).

The methods and assumptions used in the evaluation of the contamination to be expected from nuclear explosions and reactor incidents are outlined. The fission product concentration in water as a result of each of these incidents is evaluated and the results

are shown graphically. The radiological significance of water contamination is discussed by an evaluation of the danger coefficient and the factors affecting it. The significance of the study results with respect to the availability of drinking water is evaluated. (JSR)

29357 (NP-19938, pp vp, Paper 9) DIFFUSION IN FLOWING WATER OF FISSION PRODUCTS FROM REACTOR INCIDENTS. Schmitz, W. (Landes Baden-Wuerttemberg, Karlsruhe, Ger.). Nov 1971. (In German).

The transport in flowing water of radioactive materials from a reactor incident is evaluated as a function of the primary radionuclide concentration, flow-through time, dispersion, dilution of the primary contamination, sorption and desorption phenomena, and the isotope half-life. (JSR)

29358 (NP-19938, pp vp, Paper 10) ENDANGERING GROUND WATER OCCURRENCES BY RADIOACTIVE CONTAMINANTS. Aurand, K.; Kerpen, W.; Matthess, G.; Wolter, R.; Zakosek, H. (Bundesgesundheitsamtes, Berlin). Nov 1971. (In German).

The soil factors affecting the radioactive contamination of underground water as a result of radioactive fallout are described. The results of the measurement of the contamination of rain, surface waters, and underground water by radioactive fallout from 1963 to 1967 are tabulated. The distribution of ^{90}Sr and ^{137}Cs in different types of soils is measured. The migration of various radionuclides in soil columns is determined. The decontamination effects of mechanical filtration, adsorption, ion exchange, and chemical precipitation in the soil are evaluated. The radiation burden to the population by Sr, Cs, Ru, I, and radionuclide mixtures in ground water is evaluated. The ground water is classified with respect to its probable contamination. (JSR)

29359 EMPIRICAL EQUATION FOR THE PURIFICATION OF SURFACE WATERS. Lachet, B. (Centre d'Etudes, Grenoble, France); Magnaval, R. pp 185-192 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

An empirical equation describing the kinetics of surface water purification by sediments is given. The equation is of the type $C = C_0 (1 + t/a)^n$, where C_0 and C are respectively the concentration of the radioelement in water initially and after time t; a and n are parameters estimated by the least squares method and based on data from different model experiments, suspended sediments, stagnant water tanks and large pools. Values of these parameters are given for ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{60}Co, ^{85}Sr, ^{106}Ru, ^{137}Cs, ^{141}Ce, and ^{203}Hg. The advantages of this simple equation are discussed. Applications to other pollutants are foreseen. (auth)

29360 FATE OF RADIONUCLIDES DISCHARGED FROM A PWR NUCLEAR POWER STATION INTO A RIVER. Blanchard, R. L.; Kahn, B. (National Environmental Research Center, Cincinnati). pp 195-204 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

A detailed radiological study of a river in the vicinity of a large PWR nuclear station was conducted to determine the impact of the station on the environment and surrounding population. The wastes from the reactor are discharged into a 1.8-km long canal that empties into a large river. During a 1-y period samples of algae, plankton, aquatic grasses, fish, bottom sediment and water were collected from the discharge canal and from the river below and above the canal. Because the temperature of the canal water can be as much as 12.7°C higher than the river water, normal habits and growth characteristics of fish and other biological life in the canal and surrounding river waters are altered. The influence of this atypical situation on the uptake and concentration of radionuclides in the fish and aquatic plants is discussed. Radionuclides found in samples of algae, grasses, and plankton as a consequence of the discharges from the nuclear power station included ^{3}H, ^{14}C, ^{54}Mn, ^{57}Co, ^{58}Co, ^{89}Sr, ^{95}Zr, ^{95}Nb, ^{131}I, ^{134}Cs, ^{137}Cs, and ^{144}Ce. The fish were dissected for muscle, heart area, stomach, gut, bones, and liver plus kidney. Special care was exercised to remove all bones from the muscle. Radionuclides detected in the fish samples were ^{3}H, ^{14}C, ^{58}Co, ^{60}Co, ^{131}I, ^{134}Cs, and ^{137}Cs. Concentration factors for water to organism were calculated and their implications are discussed. The radiation dose to people eating the fish were estimated to be below 10 mrem/y. (auth)

29361 TRANSFER MECHANISM AND CONCENTRATING PROCESSES OF CERTAIN RADIONUCLIDES IN THE AQUATIC ECOLOGY OF THE ISMAILIA CANAL. Mahmoud, K. A.; Yousef, Y. A.; Ishak, M. M.; Abdel-Malik, W. E. Y.; Khalil, S. R.; Shafik, A.; El-Shinawy, R. M. K. (Egyptian Atomic Energy Establishment, Cairo). pp 205-215 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1937).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The behavior of certain radionuclides in the aquatic ecology of the Ismailia Canal is of great interest for the evaluation of the possible hazards that may occur to man through the movement of such radionuclides via the food chain. Laboratory investigations have been carried out to understand the accumulation and release of ^{134}Cs, ^{60}Co and ^{89}Sr by some of the biota, such as phytoplankton organisms, certain types of aquatic plants, snails and fish, the hydrological characteristics of the Ismailia Canal and the uptake by bottom sediments. The physico-chemical characteristics of Ismailia Canal water were measured periodically for 18 months to determine the seasonal variations in the conductivity, pH, total hardness, alkalinity, organic matter content, anion and cation content, etc. Laboratory investigations of the hydrological characteristics of Ismailia Canal water with respect to the relative distribution of radionuclides between water and bottom sediments were carried out. The distribution of the radioactivity in the bottom sediments was measured and computed and the results presented in the form of histograms for both flowing and non-flowing ecosystems. Possible applications of the experimental laboratory data to the natural conditions prevailing in the Ismailia Canal are also discussed. (auth)

29362 ENVIRONMENTAL BEHAVIOR OF RADIOCOBALT AND RADIOSILVER RELEASED FROM NUCLEAR POWER STATIONS INTO AQUATIC SYSTEMS. Fukai, R.; Murray, C. N. (International Lab. of Marine Radioactivity, Monaco). pp 217-242 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

To deduce the general characteristics of the behavior of radiocobalt and radiosilver released from nuclear power stations into the aquatic environment, the release situations of several existing power stations together with field data obtained to date on these and other releases are systematically assembled and reviewed. These data indicate that, although the major sink for radiocobalt is bottom sediments, some fractions tend to recycle into a soluble phase and go through complicated processes such as hydrolysis, inorganic and organic complex formation, adsorption–desorption with suspended particles and bottom sediments, etc. In the case of radiosilver the complex formation with chloride ions in the seawater medium seems to be important in maintaining this element in solution, while there are practically no data available for freshwater systems. Since these reactions have pronounced effects on the availability of the radionuclides to aquatic biota, possible specification equilibria and related geochemical behavior of cobalt and silver radionuclides in natural waters are discussed in detail on the basis of the data obtained by various workers as well as by the present authors from laboratory experiments and field measurements. An attempt is made to evaluate and compare the importance of various processes under natural conditions. Finally, the accumulation of radiocobalt by the aquatic biota is reexamined from the view point of concentration factor. Revised concentration factors are presented for some groups of marine organisms. (auth)

29363 FLOOD PLAIN TRANSFER AND ACCUMULATION OF ^{137}Cs FROM A REACTOR EFFLUENT STREAM. Ragsdale, H. L.; Shure, D. J. (Emory Univ., Atlanta). pp 243-253 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

Analysis of the flood plain swamp forest ecosystem of a reactor effluent stream in South Carolina revealed significant lateral transport of ^{137}Cs from the stream channel to the flood plain. Six flood plain transects, representing 13 miles of the stream, were extended from the stream bank into the swamp forests. Soil, root, litter, branch and leaf samples were collected at 100-ft intervals up to a distance of 300 ft along each transect. Upstream burdens of ^{137}Cs reached mean values of 225 pCi/g-d (g dry wt.) in soil and 100 pCi/g-d in vegetation, while downstream burdens were found to be 100 pCi/g-d in soil and 15 pCi/g-d in vegetation. The upstream-downstream differences indicate that significant biological cycling of radiocesium occurs upstream, while downstream there

is accumulation through immobilization in the soil. Levels of ^{137}Cs in the flood plain were variable with soils, litter and vegetation ranging from near-background to 100 pCi/g-d and roots ranging up to 340 pCi/g-d. Flood plain distribution of radiocesium correlated with topographic relief resulting in non-uniform levels of ^{137}Cs where flood plain depressions allowed for physical accumulation of radioactivity. These results lead to a rejection of the commonly assumed hypothesis of stream containment of radionuclides for streams in coastal plain areas. A new model of the fate of reactor effluents discharged to a coastal plain stream must account for discreet flooding over low banks, physical movement of suspended and soluble forms of radionuclides in terrestrial habitats, biological cycling and accumulation in the flood plain, redistribution of biologically incorporated radionuclides back to the stream, and long-term erosional movement of sedimentary radionuclear materials due to stream bed movements. (auth)

29364 ENVIRONMENTAL CAPACITY OF FRESHWATERS FOR WASTE RADIONUCLIDES. Ophel, I. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 613-624 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The maximum permissible human body burden of many radionuclides can be expressed as a specific activity, i.e., the amount of a radioisotope per unit weight of its stable counterpart. A similar concept can be applied to a large body of water that is providing water and food for man. It can be thought of as a pool or reservoir of stable elements that can dilute waste radionuclides down to specific activities less than those corresponding to the body burden. It is the size and the dynamics of this stable element pool that determine the environmental capacity of an aquatic ecosystem for a radionuclide. Results from a continuing study of strontium in an experimental lake (Perch Lake, Ontario) illustrate some of the factors that must be considered. Using elevated levels of ^{90}Sr, which have been present in the lake since 1955, it has been possible to investigate the dimensions and the dynamics of the various compartments that make up the stable strontium pool. Several of these compartments, such as lake water and some biota, have a fast turnover time (i.e., they rapidly attain a uniform specific activity); but they make up only a small fraction of the stable element pool. Other compartments of interest are the marginal vegetation and the semiaquatic animals, which cause a carry-over of ^{90}Sr into terrestrial food-chains and result in further dilution of the radionuclide. Bottom sediment is important, although a considerable fraction of the stable strontium in the sediment of Perch Lake has such a slow exchange with the lake water that it limits the effective size of this compartment. However, it is the trapping action of the sediment and the consequent removal of some radionuclides from the ecosystem that provides the continuing capacity of a lake to accept such radionuclides. (auth)

29365 BASIC PRINCIPLES FOR ESTABLISHING HEALTH PROTECTION STANDARDS WITH RESPECT TO RADIOISOTOPE CONCENTRATIONS IN SURFACE WATER BODIES. Barkhunarov, R. M.; Zaitseva, A. F.; Marei, A. N. (Inst. of Biophysics, Moscow). pp 625-632 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The public health problem of preventing radioisotopic contamination of surface water bodies can be resolved only if one has criteria for controlling the concentrations of various isotopes in the water. Different approaches have been adopted in different countries to the establishment of such criteria. Various ideas in relation to conditions in the Soviet Union are discussed. The great variety of situations encountered in practice (arising out of the different uses to which different water bodies are put and social and economic aspects of the way of life of critical population groups) makes it virtually impossible to establish a single, meaningful standard (maximum permissible concentration) for every isotope. A better approach is therefore one that takes into account local conditions while being based in all cases on the same principles, criteria and computational methods. The maximum permissible radioisotope concentrations established in the Soviet Union for water bodies relate to that part of the water body that is directly below the point of effluent discharge. The establishment of standards is based on the "critical population group," i.e., those rural inhabitants of littoral settlements who come into closest contact with the water body (fishermen, buoy-minders etc. and members of their families) or who are engaged in agriculture in the associated floodplain. It entails testing the effects of ionizing radiation on man, account being taken of various factors. One or more tests may be carried out, depending on the conditions in each particular case. Each of the factors is considered separately in assessing the effects of ionizing radiation on man, but standards are ultimately established on the assumption that all the factors may act simultaneously, the resulting values being corrected as required (one must consider not only the present situation, but also the possible long-term uses of the water body). Apart from solving immediate public health problems, the establishment of these standards has a broader purpose: it creates safe conditions for the development of fishing, irrigation-based agriculture, milk and meat production, etc. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 29295, 29768, 29790, 29849, 29850, 29863, 29867, 31629, and 31631.

29366 (BNWL-1850(Pt.2)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1973 TO THE USAEC DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH. Part 2. Ecological Sciences. Vaughan, B. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-1830. 210p. Dep. NTIS $7.60.

Twenty-one sections of the sixth annual report on research programs related to land and aquatic ecosystems and to the behavior of pollutants and radioactive contaminants in such ecosystems are presented. A separate abstract was prepared for each section. (LCL)

For abstracts of individual sections see: 29040, 29298, 29316, 29341, 29347–29350, 29367–29372, 29405–29407, 29416, 29417, 29790, and 29849.

29367 (BNWL-1850(Pt. 2), pp 1-18) ANALYSIS OF NATURAL SYSTEMS. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Our long term efforts to understand the quantitative aspects of natural systems are continuing, with a considerable emphasis on the ecological aspects of the development of nuclear power. Our recent emphasis on sampling for contaminants has been brought to the point where an exposition of certain basic aspects is feasible, and one such report was presented to the International Statistical Institute's 39th Session in Vienna last August. Efforts to model ecological systems have concentrated on radionuclide cycling and transfers, and much of the effort was devoted to appraisal of a dairy farm study, as requested by the Division of Biological and Environmental Research. Appraisals of various statistical and mathematical aspects of ecology continued along the lines of past years, with the addition of an effort to produce a bibliography of quantitative methods in ecology. (auth)

29368 (BNWL-1850(Pt. 2), pp 19-24) POTENTIAL FOR PLUTONIUM COMPLEXATION IN SOIL AND UPTAKE BY PLANTS. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Previous studies have indicated that plutonium is largely insoluble in soil over the short-term and is not accumulated by plants. However, it is possible that naturally occurring ligands in soil arising from organic matter decomposition processes may form complexes with plutonium increasing plutonium solubility in soil and uptake by plants. Furthermore, the possibility exists that the chemical form of plutonium may be directly altered by the soil microflora as has been demonstrated for other metals. The present studies were undertaken to determine (1) the effects of plutonium on the soil microbial population and on soil microbial processes, (2) the potential for formation of plutonium complexes in soil and the role of the soil microflora in this process, (3) the extent of plant uptake and translocation of plutonium or its complexes, and (4) the bond types and chemical forms of plutonium or its metabolites in microbial and plant tissues and soils. The progress of these investigations is summarized below. (auth)

29369 (BNWL-1850(Pt. 2), pp 38-41) HANFORD INTERCONTRACTOR SUPPORT. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Radioactive wastes in the Hanford environment are stored as buried liquids and solids, or as sediments in ditches and ponds. Knowledge of the behavior and fate of long-lived waste radionuclides in local biota is essential to safe handling practices

and sound environmental control. Work to date has emphasized the behavior of transuranium elements in soil-plant systems and possible interactions with other waste chemicals such as complexing and chelating agents. (auth)

29370 (BNWL-1850(Pt. 2), pp 42-50) RADIOECOLOGY OF IODINE-129. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Iodine-129 has an extremely long half-life (1.6×10^7 yr) and a low energy. It has a fission yield in the range from 1 to 1.4% depending on fuel composition and history. Predictions of potential releases to the environment have been of the order of 10^4 Ci if 1% of the ^{129}I produced by the year 2060 is released. Little attention was devoted to releases of ^{129}I in effluents of nuclear fuels reprocessing plants until recently when levels of ^{129}I were reported to be building up in the vicinity of the Nuclear Fuels Service Plant in West Valley, New York. A study has been undertaken including theoretical dose calculations, field studies of the ^{129}I presently in the environment, and laboratory studies of iodine movement in soils and plants in order to determine the long-term consequences of releases of ^{129}I to the environment. (auth)

29371 (BNWL-1850(Pt. 2), pp 130-132) FATE AND EFFECTS OF RADIONUCLIDES IN ALASKA. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Comparisons of radionuclide concentrations in rumen contents and muscle tissue of caribou from Anaktuvuk Pass and Kobuk River regions during the 1972-1973 winter season show that the Kobuk caribou are two to three times higher in ^{137}Cs concentrations. Consumption of these animals would produce two- to threefold higher ^{137}Cs body burdens in Anaktuvuk Eskimos than predicted from Anaktuvuk caribou measurements. (auth)

29372 (BNWL-1850(Pt. 2), pp 133-171) TERRESTRIAL ECOLOGY. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Terrestrial studies continue to contribute ideas and ecological data relevant to nuclear-power plant siting and the management of stored radioactive wastes in the semi-arid steppe region of Washington. These ideas and data are also largely applicable to steppe regions of Oregon, Idaho, and Nevada. Much of the available information concerning the ecology of steppe ecosystems has been gathered within the boundaries of the Arid Land Ecology Reserve, a place where long-term studies can be initiated with great assurance that the studies will not be interrupted by changing land use priorities. Today the concept of an ecological research area needs to be considered for waste management areas where opportunities are available to study the ecological behavior of radionuclides in the absence of resident human populations. These studies are relevant with the knowledge that rad-wastes will increase as a result of an expanding market for nuclear fueled power plants. The annual report for 1973 reflects the integration of terrestrial ecology studies. Papers are grouped under the headings energy and water relations, mineral nutrients, manipulation studies, consumers, primary producers, radiation studies and modelling. In mid-August, 1973, an extensive wildfire burned through pastures that served as controls for studies of the impact of cattle grazing on the shrub-steppe ecosystem. Three consecutive years of intensive collections have been made on these pastures and provide a firm baseline for evaluating the ecological consequences of burning. Fortunately, a suitable nearby acreage was not exposed to the fire and a suitable "control" has been established to permit the continuation of grassland biome studies. Radiation studies report the continuing studies of the behavior of fallout radionuclides in northern Alaska and the response of small mammals to acute radiation. A technique is described to grow range and crop plants in soil contaminated with plutonium under environmental conditions experienced in the field. Manipulation studies report on the impact of 2 years of spring cattle grazing on perennial grasses characteristic of the shrub-steppe ecosystem and the response of populations of pocket mice to the abundance of a natural food supply regulated by irrigation and herbicide treatments. A simulation model of a cheatgrass ecosystem was developed to illustrate the role of modelling in presenting the multiplicity of environmental factors that occur in an ecological system that ultimately results in plant growth and the maintenance of animal populations. (auth)

29373 (FDA-73-8029, pp 268) ENVIRONMENTAL ASPECTS OF RADIOISOTOPES EXCRETED IN NUCLEAR MEDICINE PROCEDURES. Moss, C. E.; Sternglass, E. J. (Univ. of Pittsburgh, PA). Mar 1973.

In health physics in the healing arts.

29374 (SSI-1974-2) AMOUNT OF STRONTIUM-90 IN DAIRY MILK, 1973. Suomela, J. (Statens Seruminstitut, Copenhagen (Denmark)). Jan 1974. 6p. (In Swedish). Dep. NTIS (U.S. Sales Only) $4.00.

The amount of strontium-90 in dairy milk was measured at dairies spread all over Sweden. Measurements for 1973 are given in this report. The measuring procedure is described briefly. (SW)

29375 BASIC PATTERN OF ^{90}Sr UPTAKE WITH FOOD AND FEATURES OF ^{90}Sr EXTRACTION FROM THE DIET IN THE USSR DURING THE PERIOD 1964-1971. Borisov, B. K.; Knizhnikov, V. A.; Petukhova, E. V. (Inst. of Biophysics, Moscow). pp 127-137 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The uptake with the diet of ^{90}Sr from all sources by the urban population of the Soviet Union fell from 61 pCi/d in 1964 to 16 pCi/d in 1969; during the period 1970-71 there was no further decline in the degree of foodstuff contamination. This phenomenon is attributable to the fact that the degree of atmospheric contamination declined while the concentration of ^{90}Sr in the soil remained stable. By studying foodstuff contamination levels and dietary patterns it has been possible to determine the role of individual foodstuffs as conveyors of ^{90}Sr. In particular, it has been established that ^{90}Sr uptake by the Soviet population occurs mainly through the consumption of bread and related foodstuffs rather than milk—in contrast to the United States of America and other countries with a "western" dietary pattern. Comparative data on ^{90}Sr uptake and accumulation in bone tissue for inhabitants of the USSR and a number of other countries are presented. The degree of ^{90}Sr extraction from foodstuffs is evaluated by means of two indices: the rate of accumulation and the observed ratio. In the Soviet Union these indices are about 1.5 times lower than in countries with a "western" type of diet; for example, the rate of accumulation increased from 23 to 78 over the period 1964-1971 in the Soviet Union and from 50 to 83 over the same period in the United States of America, while the observed ratio varied from 0.015 to 0.058 in the Soviet Union and from 0.054 to 0.084 in the United States of America. It has been established that there is a tendency for the difference in ^{90}Sr extraction from the diet to decrease, a tendency connected with the decline in the role of bread and related products as the main conveyors of ^{90}Sr in the Soviet Union and an increase in the role of milk and vegetables. Possible reasons why and ways in which eating habits affect the extraction of ^{90}Sr from the diet are considered. (auth)

29376 AGRICULTURAL ASPECTS OF RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT BY THE NUCLEAR POWER INDUSTRY. Bruce, R. S. (Agricultural Research Council, Wantage, Eng.). pp 273-289 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The significance of contamination of agricultural produce by radioactivity released into the environment by nuclear industry is considered. Hitherto, industrial uses of nuclear energy have exposed the population to only very small additional doses of radiation and the contribution from agricultural produce has been trivial. Under normal conditions this situation will continue, provided that the present stringent controls are maintained. However, despite all precautions the possibility of accidental releases of radioactivity cannot be entirely eliminated. Assessments of the agricultural implications of such releases from current installations have identified ^{131}I as the nuclide liable to cause the highest radiation doses because of its abundance and volatility, its rapid transfer to milk, and accumulation in the small thyroid of infants. ^{137}Cs, ^{90}Sr, and ^{89}Sr also merit consideration but would usually signify lower radiation doses. The relative importance of these nuclides may vary with new types of reactors but there is no evidence that other nuclides will become of comparable significance. Relationships between the deposition of these radionuclides on agricultural land and the contamination of diet are reviewed. Particular attention is given to the transfer of radioactivity to milk by cattle grazing contaminated pastures as this pathway can lead to the highest radiation doses. Where milk is not produced or when cattle are not at pasture the doses for a given release would be much lower. Most of the total dietary contamination will occur relatively soon after deposition. The short half-lives of ^{131}I and ^{89}Sr preclude long-term contamination, but even with ^{90}Sr and ^{137}Cs analysis of survey data shows that most of the dose commitment will be incurred

within the first 2 years. Moreover, it is most unlikely that the amount of ^{90}Sr in the soil would ever be such that agricultural produce was severely affected. In planning safeguards for the population after a reactor accident, only ^{131}I warrants consideration as a dietary contaminant. Even for this nuclide, inhalation is likely to be the dominant mode of exposure for people living close to the source and this will become relatively more important if reactors are sited close to towns. Remedial measures must take both modes of exposure into account. (auth)

29377 EFFECT OF PHYSICO-CHEMICAL PARAMETERS ON THE RADIOACTIVE CONTAMINATION OF IRRIGATED ECOSYSTEMS. Bittel, R. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). pp 291-302 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The material discussed is intended to assist in the selection of the values to be adopted in each particular situation for the parameters of radionuclide transfer from water to irrigated plants and the evaluation of the radiological capacity of irrigation water. The basis of the work is the experimental data recently derived by various laboratories in collaboration with the EURATOM-CEA Association. The radionuclides considered are the radioisotopes of ruthenium, cobalt, zinc, and chromium. The behavior of the pollutants in the various components of the ecosystem (water, soil, plants) has been studied. It depends principally on the physico-chemical form of the radionuclides discharged, the nature and concentration of the ions and compounds already present, and the kinetics of the complex equilibria existing in the environment. (auth)

29378 INFLUENCE OF AGRONOMIC PRACTICES ON UPTAKE OF FISSION PRODUCTS BY CROPS FROM SOILS OF REGIONS ADJOINING NUCLEAR INSTALLATIONS IN INDIA. Mistry, K. B.; Bhujbal, B. M.; D'Souza, T. J. (Bhabha Atomic Research Centre, Trombay, India). pp 303-320 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The influence of a variety of agronomic practices on the tranfer of ^{90}Sr, ^{137}Cs, ^{106}Ru, and ^{144}Ce to two major crops, maize and rice, from black soils was examined. These soils are typical of the regions where river and ground or well waters, to which low-level effluent discharges and accidental releases from nuclear installations, namely the Rajasthan and Tarapur Atomic Power Stations and Fuel Reprocessing Plant at Trombay, could have access, are used for irrigation. Parallel data on radionuclide uptake by plants from a typical laterite were also obtained. Studies on radiostrontium indicated that the addition of compost results in reduced uptake from both black and laterite soils. Complexing action of the polysaccharide fraction of compost on radiostrontium markedly lowers its availability to plants. Beneficial effects of liming accrue in soils with low exchangeable calcium status. A reduction in the radiostrontium content of plants was obtained with nitrogen and potassium fertilizers; photphate fertilization had no consistent effects. No significant differences were observed between various nitrogen or potassium carriers. Greater downward movement of radiostrontium in soil profiles was observed with moderately high calcium irrigation water than with either moderately high sodium irrigation water or simulated rain water. Radiostrontium was less mobile in black soil than in laterite. A flooded regime did not significantly influence the radiostrontium content of rice grown on both soils. Studies on gamma emitters indicated that, over comparable durations, ^{137}Cs uptake was markedly greater than that of ^{106}Ru and ^{144}Ce in both soil types. While ^{106}Ru uptake was higher than that of ^{144}Ce in the black soil, in the laterite ^{144}Ce uptake far exceeded that of ^{106}Ru. Compost application reduced ^{137}Cs uptake in both soils, ^{106}Ru uptake was not affected, while variable effects were observed on ^{144}Ce uptake. Flooding resulted in marked increase in ^{137}Cs, ^{106}Ru, and ^{144}Ce accumulated by rice in the laterite. In the black soil, however, a similar effect was obtained only on ^{137}Cs uptake. (auth)

29379 EXPERIMENTAL STUDIES ON THE TRANSFER TO CROPS OF CERTAIN RADIONUCLIDES PRESENT IN NUCLEAR POWER STATION EFFLUENTS. Delmas, J.; Grauby, A.; Disdier, R. (Centre d'Etudes Nucleaires de Cadarache, St-Pual-lez-Durance, France). pp 321-332 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The use in crop irrigation of water contaminated by radioactive residues contained in nuclear power stations effluents entails a risk of the transfer of various radionuclides to man. In connection with such transfer of radioactive pollutants by water and plants to the human diet, an attempt is made to define the relationship between the contamination rate of the water concerned and that of the crops harvested. To arrive at estimates that can be used by health experts, experimental models closely approximating actual conditions were utilized. A variety of fruit trees and various vegetables were contaminated by radionuclides (Cs, Co, Mn, Zn, Na) during genuine irrigation of the soil or of aerial parts of the plants. Cultivation was effected in large vats, in which the yields are comparable to those obtained in fields. An air-conditioned compartment was used for spraying. A distinction was maintained between direct and indirect contamination so that the respective hazards of the two pathways could be evaluated. Taking into account the various parameters of the environment, notably the quality of the water and the type of soil, it is intended on the basis of this work to assess the quantities of radioactive pollutants transferred through the water-soil-plant-diet chain in order to evaluate the consequences of any discharges into rivers. (auth)

29380 FACTORS DETERMINING THE INCREASED MIGRATION OF CESIUM-137 FROM THE ENVIRONMENT INTO THE HUMAN BODY. Barkhudarov, R. M.; Marei, A. N.; Novikova, I. Ya. (Inst. of Biophysics, Moscow). pp 365-372 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

Results are presented of observations carried out in various regions of the Soviet Union over a period of five years. In these regions the uptake by the rural population of ^{137}Cs from all sources with the diet, and consequently its concentration in the body, is comparatively high. Investigations have shown that the high internal radiation doses received by the population are due to the characteristics of ^{137}Cs migration within the soil-plant chain. Increased ^{137}Cs uptake from the soil by plants was observed in alluvial lowlands with various kinds of marshy ground and turfy-podsolic sandstone. It has been established that the main reason for the high migration of ^{137}Cs from such soils into plants is the absence (or low concentration) of argillaceous minerals, particularly illites, in them. The low concentration of mobile potassium in the soil and the high water content also favor migration. The coefficients of ^{137}Cs migration into plants from such soils are several factors of 10 higher than the average values for the country as a whole, with the result that the concentration of ^{137}Cs in locally produced foodstuffs, especially milk, is from 10 to 100 times higher. Determinations of the concentration of ^{137}Cs in the bodies of a large number of local inhabitants revealed differences by age and sex. Distribution curves for the probability of different ^{137}Cs concentrations in the body were obtained and exhibit a log-normal character. The maximum concentration of ^{137}Cs in the body is 6×10^{-7} Ci, with average values of $(5-10) \times 10^{-9}$ Ci. A risk assessment based on calculated population doses shows that the risk of leukemia with the existing radioactive contamination levels is low (1.7×10^{-3}%). On the basis of the results, prophylactic measures have been formulated for regions of the kind investigated. However, such measures would need to be taken only if there were a further substantial increase in environmental contamination. (auth)

29381 STUDY OF RADIOCONTAMINATION OF FISH IN THE MEUSE RIVER. Micholet-Cote, C. M.; Kirchman, R.; Cantillon, G.; Colard, J.; Koch, G. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). pp 413-427 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

Since the construction of a nuclear power station at Chooz in 1967 the water, fauna and flora of the river Meuse have been sampled regularly in order to observe their radioactive contamination. The contents of ^{90}Sr, ^{137}Cs, ^{134}Cs, ^{60}Co, and ^{54}Mn in particular have been investigated in the fish of this river, together with the distribution of these isotopes in the bone and muscle of bream. Since, generally speaking, the radioactivity of this species is low, various contamination experiments have been carried out in order to get a better idea of the radioactive contamination of fish. Minnows were chosen for the purpose of experiments. "Cold" fish were released downstream from the power station during a discharge period. After two weeks the above-mentioned gamma-

emitters were investigated in the fish that had been exposed. ^{60}Co and ^{54}Mn were studied more particularly, because they make a significant contribution to contamination of the water. Minnows contaminated artificially with 5 μCi ^{60}Co/liter or 5 μCi ^{54}Mn/liter for 7 days were transferred upstream from the power station. The values obtained after decontamination for 1 and 21 days were similar to those yielded by experiments performed entirely in the laboratory. Under laboratory conditions the water of two aquaria was contaminated with a solution of effluents from the power station. The minnows took up especially ^{137}Cs, ^{134}Cs, ^{60}Co, and ^{54}Mn in this experiment. ^{60}Co and ^{54}Mn were retained in a proportion close to that observed during contamination by radioisotopes added to the aquarium water in ionic form. The set of results obtained in the laboratory and under natural conditions is discussed. (auth)

29382 STUDY OF THE POTENTIAL RADIOLOGICAL IMPACT OF AN EXPANDING NUCLEAR POWER INDUSTRY ON THE TENNESSEE VALLEY REGION. Strauch, S. (Atomic Energy Commission, Washington, DC); Stone, G. F.; Siegel, G. R.; Cowser, K. E.; Fletcher, J. F. pp 431-447 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The US Atomic Energy Commission initiated a study in January 1970 to develop a computer model (HERMES) and the necessary data to permit estimates to the year 2000 of the radiation potentially received by individuals and population groups in large regions as a result of various estimated radioactive release rates from reactors and fuel reprocessing plants. The initial phase of the study concerned development of the computer model and data for the analysis of the region comprising the Upper Mississippi River Basin (UMRB) of the United States of America. The second phase of the study, an interagency study by the US Atomic Energy Commission and the Tennessee Valley Authority of the potential radiological impact of an expanding nuclear power industry in the Tennessee Valley Region (TVR) to the year 2000 is discussed. The Oak Ridge National Laboratory, the Hanford Engineering Development Laboratories and the Atmospheric Turbulence and Diffusion Laboratory at Oak Ridge, Tennessee are also participating in the study. The TVR region is subdivided into about 140 populations centers and the dose is calculated for the average individual in each center for each of four age groups (baby, child, teenager, and adult). Contributions to dose by isotope and pathway for each of seven body components (total body, liver, lungs, gastro-intestinal tract, thyroid, bone and skin) are determined for each of the age groups. Sensitivity analyses are also done to evaluate the effects of uncertainties in the parameters believed to be most significant in their effects on dose. The procedures, scope and HERMES model modifications established for the TVR study were guided by the results of the study of the UMRB. Those results of the UMRB that had a major effect on the planning of the TVR study are discussed. An overview of the TVR study is also provided. (auth)

29383 METHODS OF ESTIMATING DOSE TO MAN FROM REGIONAL GROWTH OF NUCLEAR POWER. Cowser, K. E. (Oak Ridge National Lab., TN); Booth, R. S.; Witherspoon, J. P.; Fish, B. R.; Snyder, W. S.; Siegel, G. R.; Wilkie, W. H. AT(45-1)-2170. pp 467-482 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

In co-operation with the United States Atomic Energy Commission (USAEC), the Oak Ridge National Laboratory (ORNL), the Tennessee Valley Authority (TVA), the Atmospheric Turbulence and Diffusion Laboratory--National Oceanographic and Atmospheric Administration (ATDL-NOAA), and the Hanford Engineering Development Laboratory (HEDL) have undertaken a joint study of the potential radiological impact of an expanding nuclear power economy on the Tennessee Valley Region (TVR). The TVR study involves an appraisal of the generation, management, and control of radioactive effluents from nuclear facilities in the region to the year 2000. Consideration is given to nuclear power requirements to the year 2000 and sites for nuclear facilities, to radionuclides that may be released and their transport in air and water and concentration in terrestrial and aquatic systems, and to the estimation and interpretation of the potential dose to man. This is the second such regional study initiated by the USAEC in the continental United States of America, the first considering the region defined as the Upper Mississippi River Basin (UMRB). A computer model known as HERMES (Hanford Engineering Regional Model for Environmental Studies) was developed by HEDL and applied in the UMRB study. The model permits estimates, on a regional basis, of the potential radiation dose that may be received by individuals and population groups as a result of radioactive materials estimated to be released from reactors and fuel reprocessing plants. Modifications in Hermes are discussed within the context of the uniqueness of the TVR and additions or improvements based on the initial application of HERMES. Information is included on the data requirements and the components of HERMES concerned with the estimation of dose to man from internal and external modes of exposure. (auth)

29384 ESTIMATING DOSE COMMITMENTS TO POPULATIONS FROM RADIOACTIVE WASTE DISPOSALS INTO LARGE LAKES. Barry, P. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 499-506 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

A radiation dose commitment is a measure of the long-term consequences for a population of a practice leading to the irradiation of its members. An estimate of a dose commitment is useful for assessing the trend when long-lived radionuclides are released into the environment. In this case the per caput dose rate when equilibrium is eventually reached is numerically equal to the dose commitment per unit rate of release. An estimate of the dose commitment per unit released is therefore a necessary parameter for consideration at an early stage in planning the development of an area for the disposal of low-level radioactive waste. An important area in North America for this purpose is the Great Lakes basin. An abundance of cooling water and a large growing population combine to make the shore lines of the lakes attractive sites for nuclear power stations. It is reasonable therefore to expect that some low-level radioactive wastes will enter the lakes. Because of the importance of the lakes for other purposes, their use for waste disposal should be carefully planned. A preliminary attempt has been made to estimate the dose commitment following the release of radioactive wastes with particular reference to the release of ^{137}Cs to the lower lakes. The dose commitment following a release of one curie of ^{137}Cs into Lake Huron is 0.4 man-rem. This estimate is very crude. The purposes for making it at this time were to estimate the order of magnitude; develop computation models; and discover the sensitivity of the estimate to assumptions so as to define the most important variables for experimental investigation. Analyses to date suggest that the distribution of fish feeding and harvesting areas and the kinetics of exchange between sediments and water are particularly important areas for future study. (auth)

29385 STUDIES OF DOSE PATHWAYS FROM A NUCLEAR FUEL REPROCESSING PLANT. Magno, P. J. (Environmental Protection Agency, Washington, DC). pp 537-551 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

Nuclear Fuel Services operates the United States' first commercial nuclear fuel reprocessing plant in western New York State. Studies were carried out by the US Environmental Protection Agency to characterize the waste discharges from the plant and to determine the radiation doses to the population living in the vicinity of the plant. Included as a part of these studies was an evaluation of the radiation doses to the exposed population from ingestion of fish and deer during 1971. The procedures and data used in evaluating these dose pathways are presented. Dose estimates for the fish and deer pathways indicated that the integrated whole-body population dose from each of these pathways was about 0.1 man-rem during 1971. The maximum whole-body dose an individual could have received from ingestion of venison was 14 mrem. The maximum dose to an individual from the fish pathway was estimated to be 1.4 mrem whole-body and 7 mrem to bone. The data on the fish pathway indicated that the external whole-body doses received while fishing were greater than the doses received from ingestion of fish. (auth)

29386 HEALTH PHYSICS PROGRAM AT THE NEVADA TEST SITE EXPERIMENTAL FARM. Douglas, R. L. (Southwestern Radiological Health Lab., Las Vegas, NV). pp 349-360 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The passage of radioiodine through the forage-cow-milk food chain was investigated as a part of the bioenvironmental research program. Artificially generated ^{131}I-labeled aerosol was released in the irrigated forage area, which contained air samples and fallout collectors. After the forage was harvested and fed to cows the milk and forage were analyzed by gamma spectroscopy. Descriptions are given of the facilities, methods of air contamination, and methods of surface contamination and decontamination. Other experiments were conducted on fallout contamination released from Plowshare excavation experiments. Contaminated hay was fed to dairy cows and sampling and analysis procedures are described. Results indicated that the spread of contamination could be minimized under the prevailing field conditions. (HLW)

29387 CONTROL AND DISTRIBUTION OF URANIUM IN CORAL REEFS DURING DIAGENESIS. Gvirtzman, G.; Friedman, G. M.; Miller, D. S. (Rensselaer Polytechnic Inst., Troy, NY). J. Sediment. Petrol.; 43: No. 4, 985-997(Dec 1973). (COO-3462-10).

The concentration of about 2 ppM of uranium in the aragonitic skeletons of modern scleractinian corals which we studied is a constant value, regardless of occurrence, anatomy, or taxonomy. The presence of cement of aragonite or high-magnesian calcite usually raises the concentration of bulk samples to about 3 ppM. Modern corals may contain up to 50% of cementing minerals. Organisms, such as corals and coralline algae, while secreting their skeleton, discriminate against the uptake of uranium, whereas the uptake of uranium by mineral cements is less restrained. Aragonite cement contains about 3.6 ppM and high-magnesian calcite cement 2.6 ppM uranium. During leaching by freshwater, the aragonite of the skeletons of corals dissolves out. This creates hollow molds which fill with drusy low-magnesian calcite. In emergent reefs from the shores of the Red Sea which display the effects of progressive diagenesis this calcite is enriched in uranium (3.9 ppM) beyond that found in marine cements. Second-generation calcite, which fills original voids in the corals from the emergent reefs, contains a lower level of uranium concentration (1.3 ppM). The level of concentration of uranium in low-magnesian calcite of diagenetically altered corals is a function of the availability of uranium in meteoric waters. In aragonite as well as in high- and low-magnesian calcite uranium replaces calcium or occupies lattice vacancies in the crystal lattice. (auth)

29388 RADIONUCLIDE DYNAMICS IN INSECT FOOD CHAINS. Reichle, D. E.; Van Hook, R. I. Jr. (Oak Ridge National Lab., TN). Manitoba Entomol.; 4: 22-32(1970).

From conference on ionizing radiation in entomology; Winnipeg, Canada (24 Aug 1970).

Knowledge of food chain dynamics is a prerequisite to understanding the fate of chemical compounds in ecosystems, since food chains are the primary biological mechanisms for the dispersal and concentration of radionuclide contaminants in the environment. The dynamics of material transport along insect food chains has received considerable attention in recent years, and mathematical models have been developed describing the variables affecting the behavior of radionuclides in food chains. Knowledge of uptake, assimilation, and metabolic turnover of radionuclides has led to predictable models of transient behavior of materials along food chains, resultant trophic level concentrations, and efficiencies of trophic level exchange. (auth)

29389 RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT AND ITS EFFECTS ON LIVESTOCK AND FOOD OF ANIMAL ORIGIN. Kreuzer, W. (Univ., Munich). Arch. Lebensmittelhyg.; 24: No. 5, 104-108(May 1973). (In German).

From first European congress of veterinarians and tenth meeting of German veterinarians; Wiesbaden, Ger. (11 Sep 1972).

External and internal natural radiation exposure seems to be relatively and absolutely higher in livestock, mainly in herbivores, than in man. The artificial internal and external radiation exposure hardly exists in animals, even not in the vicinity of nuclear reactors. The external radiation exposure resulting from the radionuclides of the fallout of nuclear weapon experiments was negligibly small in Central Europe. The internal radiation exposure after intake of radionuclides with food of animal origin and their accumulation in the organism of the consumer is important. Milk and dairy products may contain considerable amounts of ^{131}I, ^{137}Cs, and ^{90}Sr. In meat, ^{137}Cs-contaminations were found sporadically that were higher than the permissible maximal dose. In total, the artificial radiation exposure did not yet reach the dimensions of the natural radiation exposure, neither in livestock nor in men, even not in reindeers or their breeders in Lapland, where the extreme ^{137}Cs-contamination of the lichen causes high ^{137}Cs-activity, both in reindeers and in reindeer breeders who live almost exclusively on meat, blood, and milk of the animals. The radioactive contamination of livestock and food of animal origin may cause concern in case of a crisis or emergency. (GE)

Radiometric Techniques

Refer also to abstracts 29005, 29052, and 29102.

29390 (BNL-18625) 1973 ENVIRONMENTAL MONITORING REPORT. Hull, A. P.; Ash, J. A. (Comps.). (Brookhaven National Lab., Upton, N. Y. (USA)). Mar 1974. 73p. Dep. NTIS $6.75.

Results from radiation monitoring during 1973 in the environment of the Brookhaven National Laboratory are presented. Data are included on: the gross α and β activity and content of tritium and gamma-emitting radionuclides in surface air; gross β activity and gamma and tritium content in atmospheric precipitation; activities and concentration of gamma emitters in liquid effluents and ground water; gross β, tritium and ^{90}Sr in effluents; gross β and tritium in surface waters; ^{90}Sr and gamma-emitting radionuclides in river ecosystem; gross α, gross β, tritium, ^{90}Sr, and ^{137}Cs in ground and well water; ^{137}Cs, K, ^{131}I, and ^{90}Sr content in area milk; and gamma-emitting radionuclides in soils and grasses. (LCL)

29391 (CEA-CONF-2473) DATING; RADIOTHERMOLUMINESCENCE WITH THERMOSTIMULATED EXOELECTRON EMISSION. Portal, G.; Petel, M.; Francois, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). May 1973. 13p. (In French). (CONF-730575-8). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on application of nuclear data in the field of work of art; Rome – Venice, Italy (24 May 1973).

The theoretical aspects of two methods of dating art objects are presented: radiothermoluminescence and a technique based on thermostimulated exoelectron emission. The characteristics of the two procedures are described, and the advantages of each method are compared. (JSR)

29392 MEASUREMENTS OF THE THERMAL NEUTRON MEAN LIFETIME OF ROCK FORMATIONS BY MEANS OF A BOREHOLE NEUTRON GENERATOR. Chrusciel, E.; Massalski, J.; Morstin, K.; Starzec, A. (Inst. of Nuclear Techniques, Krakow). Acta Geophys. Pol.; 21: No. 4, 325-348(1973).

The status of a pulsed neutron logging technique in Poland is presented. The problems connected with the proper determination of the neutron lifetime of rock formations and concerned geological quantitative interpretation are discussed. The interfering influence of background radiation in measurements with gamma-ray detection has been eliminated by introducing the three-gate symmetrical detection system. Some pulsed neutron measurements, performed with the use of three-gate detection in cased holes, are described. For intervals of relatively uniform lithology, the obtained results correlate with the indications of standard open-hole logging methods. Conclusions concerning the further development of pulsed neutron techniques in well-logging are given. (auth)

29393 METHOD FOR SIMULTANEOUS MEASUREMENT OF RADIOACTIVE AND INACTIVE CO_2 EVOLVED FROM SOIL SAMPLES DURING INCUBATION WITH LABELED SUBSTANCES. Domsch, K. H.; Anderson, J. P. E.; Ahlers, R. (Forschungsanstalt fuer Landwirtschaft, Brunswick). Appl. Microbiol.; 25: No. 5, 819-824(May 1973).

An apparatus is described that allows the simultaneous, continuous, and highly sensitive analysis of inactive and radioactive CO_2 evolved from ^{14}C-supplemented soils or other materials. The apparatus consists of a control unit, a commercially available conductometric CO_2 analyzer, and a fraction collector. A number of model experiments were conducted to demonstrate the potentials of the apparatus. These included analysis of the time course of priming action, when ^{14}C-glucose was added to soil, separation of CO_2 respiration peaks caused by simultaneous degradation of radioactive and inactive soil supplements, and study of the effects of a fungicide, Benomyl, on degradation of ^{14}C-labeled glucose. In the last experiment, partial degradation of the fungicide could also be followed. (auth)

29394 NEW SAMPLE COMBUSTION BOMB FOR RADIOCARBON DATING. Switsur, V. R.; Burleigh, R.; Meeks, N.; Cleland, J. M. (Cambridge Univ., Eng.). Int. J. Appl. Radiat. Isotop.; 25: No. 3, 113-117(Mar 1974).

The oxidation of organic samples with high pressure oxygen in a combustion bomb is now well known, especially in the field of radiocarbon dating and other disciplines where a gaseous product is required for subsequent measurements. This is very rapid, efficient, clean and convenient providing that the correct procedure is adopted and carried out in properly designed and constructed apparatus. Possible dangers of deviating from the approved procedure and using unsuitable equipment are enumerated. A design of a safe combustion bomb is described. (auth)

Site Surveys

Refer also to abstracts 29303, 29311, 31146, 31160, and 31187.

29395 (AECL-3956) HABITATS OF SMALL MAMMALS AT WHITESHELL NUCLEAR RESEARCH ESTABLISHMENT. Iverson, S. L.; Turner, B. N. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Dec 1973. 58p. Dep. NTIS (U.S. Sales Only) $6.00. AECL $1.50.

The small mammals in the area around the Whiteshell Nuclear Research Establishment in southeastern Manitoba were sampled by approximately 110,000 snap-trap nights in a 5 year period. Habitats trapped were divided into major types on the basis of the tree species present, and occurrences of the different species of shrubs and herbs in each habitat type were noted. The major habitats were mixed deciduous, aspen, ash, mixed coniferous, black spruce and fir forests; black spruce bog and open field. The small mammal component of the mixed deciduous forest was dominated by Peromyscus maniculatus and Clethrionomys gapperi, but all of the other species included in this study were also present. In both aspen and ash forests, Microtus pennsylvanicus and C. gapperi were the most numerous species, with Sorex arcticus reaching its greatest abundance in the latter. In the open field, M. pennsylvanicus was most abundant, followed by Zapus hudsonius, C. gapperi, M. pennsylvanicus and Sorex cinereus were the most numerous mammals in the black spruce bog community, and also extended into the black spruce forest. All of the species studied, except Napaeozapus insignis and S. arcticus, were present in the mixed coniferous forest. S. arcticus and S. cinereus, although captured in habitats ranging from heavy forest to open field, appeared to be most numerous in young forests and other intermediate habitats. Blarina brevicauda was most numerous in older forests. P. maniculatus and N. insignis were most common in the mixed deciduous forest, but P. maniculatus occurred more frequently than N. insignis in the younger forests. P. maniculatus showed a significant positive relationship with large tree diameter and low percentages of ground cover. C. gapperi was captured in highest numbers in the mixed deciduous and coniferous forests, but was also found in the other types of forest in greater numbers than P. maniculatus. M. pennsylvanicus and Zapus hudsonius were most common in the open field, but both species were present in the forests. Analysis of data from stations in the forest where M. pennsylvanicus was captured showed that this vole was most common in areas structurally most similar to open field, that is, areas with small trees and more ground cover. Most of the species were captured in a greater range of habitats than has been generally reported. This may be due to gene flow between eastern and western subspecies, the physical proximity of the different habitats, and more thorough sampling including long-term intensive snap-trapping. (auth)

29396 (ANL/ES-40(Vol.7)) ENVIRONMENTAL STATUS OF THE LAKE MICHIGAN REGION. Volume 7. Earthquake History and Measurement with Application to the Lake Michigan Drainage Basin. Keener, R. B. (Argonne National Lab., Ill. (USA)). Feb 1974. Contract W-31-109-eng-38. 18p. Dep. NTIS $4.00.

Major risk areas of the United States (the 48 contiguous states) are defined, and a very brief inventory of a few of the major earthquakes that occurred or have otherwise been felt in the country is given. A review of the methods of measuring and categorizing seismic events is discussed, with the objective to correct any misunderstanding in regard to their meaning. Lake Michigan Drainage Basin seismicity is described, covering earthquakes with a maximum felt intensity as small as II. Earthquakes which have taken place outside of the Basin but were felt within it are tabulated also. Finally, a short section regarding theories of earthquake prediction is included. (auth)

29397 (LA-5540-MS) SELECTED PHYSICOCHEMICAL PROPERTIES OF BASALTIC ROCKS, LIQUIDS, AND GLASSES. Krupka, M. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

Fundamental data on properties of rocks are required for the engineering development of rock-melting systems (Subterrenes). Selected physicochemical properties of basaltic rocks, liquids, and glasses are presented including viscosity, thermal diffusivity, thermal conductivity, specific heat, density, thermal expansion coefficient, and average chemical composition. (auth)

29398 (NP-19938, pp vp, Paper 1) STATUS OF DRINKING WATER SUPPLY IN THE GERMAN FEDERAL REPUBLIC. Roeber, H. (Bundesministerium des Innern, Bonn). Nov 1971. (In German).

The evolution of the water requirements in the German Federal Republic between 1950 and 1970 is discussed and shown in tabular form. Industrial needs for water are outlined. Environmental dangers to the water supply are briefly indicated. The drinking water needs in times of emergency are evaluated. (JSR)

29399 (NVO-1253-5) HYDROLOGIC DATA BANK USERS GUIDE. User Information Bulletin 4. Lakeotes, C. D.; Friesen, H. N. (Nevada Univ., Reno (USA). Desert Research Inst.). Jan 1974. Contract AT(29-2)-1253. 26p. Dep. NTIS $4.50.

The AEC/NV Hydrologic Data Storage and Retrieval System is composed of data files and computer programs for the manipulation of these files. This Bulletin presents the names assigned to the data files, outlines the file contents, and documents the procedures for retrieving desired data. (auth)

29400 (ORNL-EIS-74-67) FISH PROTECTION AT INTAKE STRUCTURES AND DAMS; GUIDANCE, SCREENS AND COLLECTION DEVICES. A Selected Bibliography With Abstracts. Huber, E. E. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 74p. Dep. NTIS $6.75.

This annotated bibliography of 195 items was prepared by the Environmental Response and Referral Group of the Environmental Information System Office in connection with the Environmental Impact Reports Project at Oak Ridge National Laboratory. Published and unpublished material available from libraries or government agencies was included. The collection contains selected material relating to the protection of fish under adverse conditions created by man-made diversions and obstacles such as dams, canals, intake structures for power plants, and irrigation projects. It is particularly concerned with screening fish from intake structures and methods for guiding fish around obstacles or out of danger zones. It covers all types of fish screens, louvers, fish pumps, fish locks, elevators, barriers, and the use of sound, light and chemicals to guide fish. Some material on the design and use of fishways and bypasses has been included, but this subject is not covered in depth. The bibliography is categorized by primary and secondary subject. Author, taxonomy, keyword, and permuted title indices are included. (auth)

29401 (ORNL-NSF-EP-67) COMPUTER AUGMENTATION OF SOIL SURVEY. Interpretation for Regional Planning Applications. Meyers, C. R. Jr.; Durfee, R. C.; Tucker, T. C. (Oak Ridge National Lab., Tenn. (USA)). Apr 1974. Contract W-7405-eng-26. 51p. Dep. NTIS $5.75.

Interpreted soil data are a needed ingredient in all levels of the planning process; however, with the time delay between soil scientists' field work and published soil maps and the changing variety of soil interpretations needed by planners, much of the potential usefulness is lost. A joint working agreement between the Oak Ridge National Laboratory Regional Environmental Systems Analysis Program, the Computer Sciences Division, and the State of Tennessee Soil Conservation Service has resulted in the development of a computer information system which accepts raw field data, thereby allowing soil interpretations to be made and mapped quickly. Steps to implement the system include: (1) generation of computer-drawn field sheet grid overlays, (2) delineation of gridded soil boundaries by soil scientists, (3) digitization of these soil boundaries, (4) production and editing of quick-look soil maps, (5) computer generation of various scale soil maps, and (6) soil interpretation and mapping. Utilizing such a system has allowed decisions to be made easily concerning definition of soil boundaries, soil interpretations, etc. These interpretation maps may then be integrated into the planning process by the regional planner. Implementation of this system has produced solutions to many problems of both soil scientists and planners, thus closing the gap between the two sciences. (auth)

29402 (ORNL-TM-4370, pp 359-367) ENVIRONMENTAL SURVEYS. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

Comprehensive surveys to assist in the assessment of environmental effects associated with milling of uranium ores, production of power at nuclear power plants, and usage of toxic metals and compounds are in progress or approaching completion. Surveys on the use and disposition of mercury in the United States, as well as on biological response to proprietary chemicals used in cooling water, are in progress. (LK)

29403 (ORNL-TM-4498) ENVIRONMENTAL IMPACTS ASSOCIATED WITH ELECTRIC TRANSMISSION LINES. Kitchings, J. T.; Shugart, H. H.; Story, J. D. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 109p. Dep. NTIS $7.50.

Expansion of electrical generating facilities has necessitated a concomitant growth in transmission line facilities. Since inspection, maintenance, and repair by work crews must be performed, the requirements of the line corridors include accessibility, even in remote areas. Also endemic ecological systems are altered to produce a stabilized, low-growing plant community desired by the utility. The routing, construction, and maintenance procedures employed can cause significant changes in the terres-

trial systems traversed by the lines and in the adjacent aquatic systems. In lands modified by utility right-of-way corridors, the most abundant animal species are those which have such varied requirements for survival that they can readily adapt to the transitory, unstable conditions that are encountered. Game species such as the ruffed grouse, mourning dove, bobwhite, and cottontail rabbit are examples which thrive in succession stages. However, encroachment on climax communities may result in considerably more severe alterations. Species that thrive under climax conditions are generally more specialized in their requirements for survival, and alteration or reduction of their habitat can lead to eradication of a whole species. Erosion resulting from clearing of right-of-way corridors or the construction of maintenance roads may result in a significant interaction between terrestrial transmission line systems and adjacent aquatic environments. The loss of nutrients, gullying, and decreased water-holding capacity are important terrestrial events related to erosion. The loss of nutrient minerals from the landscape leads to a decreased productivity, since much of the nutritional requirements of terrestrial ecosystems depends on mineral cycles sustained by surface organic components, which are the most readily removed by surface erosion. Cutting for transmission line facilities is usually followed by the application of a herbicide to suppress unwanted vegetation. Studies have demonstrated that allowing growth and development of successional vegetation by not using herbicides minimizes the nutrient losses by channeling waters from runoff to evapotranspiration and by incorporating the released available nutrients into the rapidly developing biomass of successional vegetation. Extensive clearing for maintenance roads on steep slopes or in stream channels also can increase erosion, which in turn may affect water quality for long periods in adjacent streams by increasing the sediment load. Building maintenance roads away from streams or leaving buffer strips to decrease sedimentation can aid in protecting the aquatic habitat. Information on the acute effect of herbicides and insecticides is presented. Ozone toxicity to both plants and animals is briefly reviewed. Data needed most for impact evaluation are those which identify the ecological changes resulting from creation of strip openings through forest areas. An evaluation procedure for identifying how the construction and maintenance programs will affect the integrity of the ecological community is presented. (auth)

29404 (UCRL-51526) HIGH-PRESSURE MECHANICAL PROPERTIES OF KAYENTA SANDSTONE. Duba, A. G.; Abey, A. E.; Bonner, B. P.; Heard, H. C.; Schock, R. N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Feb 1974. Contract W-7405-eng-48. 24p. Dep. NTIS $4.00.

Pressure-volume, uniaxial strain loading, uniaxial stress loading to failure, and ultrasonic velocity determinations have been performed on samples of Kayenta sandstone from the site of the Mixed Company event. Hydrostatic pressure of 3 GPa produces about 23% volume compression, with 9% permanent compaction remaining upon unloading. The pressure-volume data indicate that crush-up of porosity begins between 200 and 300 MPa. In uniaxial strain loading, the sandstone loads directly to the vicinity of the failure envelope, then parallels that envelope to the highest confining pressure (480 MPa). At strain rates of about 10^{-4}/s, the loading path in uniaxial strain up to 200 MPa is coincident in pressure-volume space with the shock-loading path (at a strain rate of about 10^{5}/s) observed on samples from the same block. The permanent compaction, after unloading under conditions of uniaxial strain from 625 MPa mean pressure, is about 3.6%. Uniaxial stress loading indicates a brittle-ductile transition between 400 and 500 MPa mean pressure. Between 100 and 500 MPa mean pressure, the slope of the failure envelope is decreased considerably with respect to that below 100 MPa and between 500 and 900 MPa. This plateau, which is not present in the failure envelope for material subjected to a 700-MPa confining pressure before the uniaxial stress test, is interpreted as being due to pore crush-up during hydrostatic loading. As confining pressure is increased from 0.1 MPa to 1 GPa, the measured compressional velocity increases from 3.0 km/s to 5.0 km/s and the shear velocity increases from 1.5 km/s to 2.4 km/s. Small decreases in compressional velocity (~5%) between 10 and 40 MPa are attributed to local brittle failure resulting from highly localized stress concentrations within the sample under hydrostatic loading. (auth)

Thermal Effluents

Refer also to abstracts 29311, 29366, 31205, and 31355.

29405 (BNWL-1850(Pt. 2), pp 57-63) EFFECTS OF THERMAL DISCHARGE ON AQUATIC BIOTA. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Temperature in aquatic environments not only acts directly on a cold-blooded organism by influencing survival at thermal extremes, but also indirectly in often subtle and insidious ways. Both the direct and indirect effects of thermal alterations from man-made sources remain unknown for most aquatic biota because, as a diverse group, they are characterized by extreme ranges in form, habits, distribution, life cycles, and environmental requirements. Studies were designed to quantify the ecological impact of temperatures on the more important vertebrate and invertebrate inhabitants of aquatic systems. The program is intended to be creative. It requires the recognition of unusual direct and indirect effects, the development of innovative approaches to examine them, and the cooperation of interdepartmental disciplines to solve them. Studies of the interaction of temperature with other environmental stresses and the relationship of temperature to physiological requirements are integral parts of this program. (auth)

29406 (BNWL-1850(Pt. 2), pp 64-68) EFFECTS OF THERMAL DISCHARGES ON FISH BEHAVIOR AND SENSORY PHYSIOLOGY. Jan. 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Knowledge of the behavioral response of free-roaming fishes to thermal discharges is important to understanding the influence such discharges could have on their ecology. Studies begun in fiscal year 1974 are investigating the response of salmonid fingerlings to warm water discharges into model raceways. It is intended that the studies will eventually be validated in the field. A second phase of this program addresses the effect of exposure to elevated temperatures on the sensory physiology of fish. Utilizing conditioning procedures, the sensory functions of fishes will be tested before and after thermal shock. (auth)

29407 (BNWL-1850(Pt. 2), pp 69-78) COMBINED EFFECTS OF TEMPERATURE, POLLUTANTS, AND DISEASE. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Aquatic biota in the natural state are often exposed to several stressors simultaneously. The ecologist today is often required to assess the impact of warm water chemically polluted effluents on fishes and other life forms. The literature presently contains little information on the combined effects of such factors, be they synergistic, antagonistic or simply additive. This program is designed to provide this information. Currently the studies consider the combined effects of warm water and chemical additives used in treating power plant cooling makeup water, e.g., biocides and corrosion inhibitors. (auth)

29408 (BNWL-SA-4881) BUOYANT PLUME MODEL FOR PEDESTRIANS. Slinn, W. G. N. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-1830. 31p. (CONF-740302-2). Dep. NTIS $3.75.

From symposium on cooling tower environment-1974; College Park, Maryland, USA (4 Mar 1974).

Equations for the steady-state rise of a buoyant plume are derived directly from the conservation laws for mass, momentum and energy. Top-hat profiles are used and it is assumed that there is no horizontal pressure gradient across the plume's boundary. In the resulting equations there are four unspecified quantities: the drag and heat transfer coefficients, the entrainment velocity and heat production. Results are shown for the (isentropic) case when all these quantities are zero as well as for cases with various combination of these quantities different from zero and using simple relaxation models. In this way some insight is gained into their separate effects on the plume's properties. Results of a simple model to account for a mean wind are also demonstrated. The need for more field data is obvious. (auth)

29409 (BNWL-SA-4888) ANALYTICAL SEARCH FOR THE STOCHASTIC-DOMINATING PROCESS IN THE DRIFT-DEPOSITION PROBLEM. Slinn, W. G. N. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1974. 26p. (CONF-740302-3). Dep. NTIS $3.50.

From symposium on cooling tower environment-1974; College Park, Maryland, USA (4 Mar 1974).

The random processes in the drift-deposition problem are examined separately to see if any one of them dominates the statistical properties of the outcome. The three prime candidates are assumed to be the drop size distribution, the distribution of break-away points, and turbulent diffusion. It is seen that the drop size distribution probably has dominant influence on the

deposition of the large-size (drift or carry-over) drops. Turbulence has a comparable influence on the deposition of the small drops for downwind distances of the order of 10 tower heights and then dominates for large downwind distances, provided the atmosphere is not stable. Uncertainties in details of how the drops break free from the plume's updraft preclude an accurate evaluation of this effect and seriously limit the accuracy of any drift-deposition prediction. To remedy this, more field data is needed. (auth)

29410 (CONF-740317-1) USES OF POWER PLANT DISCHARGE WATER IN GREENHOUSE PRODUCTION. Bond, B. J.; Furlong, W. K.; King, L. D.; Madewell, C. E.; Martin, J. B. (Tennessee Valley Authority, Muscle Shoals, Ala. (USA); Oak Ridge National Lab., Tenn. (USA)). 1974. 20p. Dep. NTIS $4.00.

From conference on the use of waste water in the production of food and fiber; Oklahoma City, Oklahoma, USA (5 Mar 1974).

A TVA research study on the use of waste heat in thermal effluents from power plant, fossil-fired or nuclear, for environmental control in greenhouses is described in terms of the engineering objectives, horticultural objectives, design, operation, and performance testing of the greenhouse facility, and preliminary results with an empty greenhouse and one used to grow cucumbers. The engineering system has performed as designed to date, although modifications to permit future performance evaluations are planned. The horticultural production has been satisfactory to date and other crops, varieties, and rooting media will be tested to increase production. (LCL)

29411 (COO-2158-11) INVESTIGATION OF THE INFLUENCE OF THERMAL DISCHARGE FROM A LARGE ELECTRIC POWER STATION ON THE TEMPERATURE AND NEAR-SHORE CIRCULATION OF LAKE MICHIGAN. Quarterly Progress Report, 1 January 1974–31 March 1974. Mortimer, C. H.; Sato, G. K. (Wisconsin Univ., Milwaukee (USA). Center for Great Lakes Studies). 1974. 4p. Dep. NTIS $4.00.

Data on the effects on the temperature distribution and near-shore flow patterns in Lake Michigan caused by the into-lake discharge of thermal effluents from the Oak Creek Power Plant are reported. Information is included on: wind and water current measurements; temperature variations; spectral analysis of lake current data; and thermal plume measurements taken at the power plant. (LCL)

29412 (COO-2161-19) MICROBIOLOGY OF THERMALLY POLLUTED ENVIRONMENTS. Technical Progress Report, August 1, 1973–July 31, 1974. Brock, T. D. (Wisconsin Univ., Madison (USA). Dept. of Bacteriology). 1 Apr 1974. Contract AT(11-1)-2161. 63p. Dep. NTIS $6.25.

Thermal pollution is discussed with regard to sources of man-made thermal water; thermal consequences of thermal pollution; and thermal effects on water quality. Natural habitats receiving thermal additions are discussed with regard to geothermal habitats and geothermal modification of normal aquatic ecosystems. Ecological observations on geothermal habitats include upper temperature limits for various taxonomic groups and consequences of species restriction by temperature. General ecological consequences of thermal pollution are discussed with regard to differences between thermal effects on cold and warm water habitats; adaptation to the thermal environment; effect of temperature on growth rate; temperature and water quality; and bacterial indicators of thermal pollution. (HLW)

29413 BUOYANT JETS WITH THREE-DIMENSIONAL TRAJECTORIES. Hirst, E. (Oak Ridge National Lab., TN). J. Hydraul. Div., Amer. Soc. Civil Eng.; 98: No. HY11, 1999-2014 (Nov 1972).

A new integral method is devised to predict the hydrothermal behavior of buoyant jets discharged to infinite, flowing, stratified ambients through single submerged diffusers. The method, based on an integration of the basic partial differential equations written in a natural coordinate system, is more general than previous methods. In addition, a new generalized entrainment function is defined which includes the effects of internal turbulence, buoyancy, jet orientation, and cross flow. Only one of the 4 entrainment coefficients is obtained by fitting predictions to data. Theoretical predictions are compared with 29 different flows. Agreement between theory and data is good; this is significant as the range in experimental flow variables is considerable and the 4 entrainment coefficients are maintained constant for all predictions. (auth)

29414 HYDROTHERMAL ANALYSIS BY FINITE ELEMENT METHOD. Luziuk, L. A. (Sargent and Lundy Engineers, Chicago); Anderson, J. C.; Belytschko, T. J. Hydraul. Div., Amer. Soc. Civil Eng.; 98: No. HY11, 1983-1998(Nov 1972).

The finite element method is used to predict the horizontal temperature distribution resulting from the discharge of a heated effluent into a body of water. The methods of heat transfer include the heat exchange at the air-water interface, advection, and diffusion. The 2-dimensional steady state solution to the governing field equation is approximated by applying Galerkin's method. Comparison of the numerical solution with the exact solution for a 1-dimensional example is in good agreement. The analytical procedure is also used to predict the distribution of a heated effluent which is discharged into a river, and the results are compared with those obtained for a model study. The analytical technique can be applied to rivers, lakes, or cooling ponds. (auth)

29415 EFFECTS OF DISTORTION IN A RIVER MODEL FOR TEMPERATURE PREDICTION. Chien, Y. M. Ames, IA; Iowa State Univ. (1973). 143p. University Microfilms Order No. 74-524.

Thesis (Ph. D.).

A series of models simulating the Quad-Cities section of the Mississippi River were constructed for studying the effects of model distortion on heated effluent dispersion. The problem was analyzed according to similitude theory. Twenty-six significant parameters were considered, resulting in 22 dimensionless ratios or π-terms. By proper choice of working fluid plus actual measurements and calculations, the number of π-terms was reduced to 10. Because of limitations of materials, a true model can not be constructed. The conventional approach to the design of a fluid model is to use two or more different scales, such as one for horizontal scale and another for vertical scale, hence the term "Distorted Models." A total of 5 models were constructed according to 9 design criteria. Whenever distortions were encountered during the operation, the magnitude of their effects was evaluated. Cross correlations were made among the models to determine the gross distortion effects and prediction factors were evaluated to offer a higher order of accuracy to predictions. (Diss. Abstr. Int., B)

Chemical Effluents

Refer also to abstracts 29067, 29311, 29335, 29366, 29407, and 31634.

29416 (BNWL-1850(Pt. 2), pp 35-37) FATE AND EFFECTS OF OIL ON MARINE COASTAL ECOSYSTEMS. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Data are presented from the determination by gas chromatography of the soluble aromatic hydrocarbons in suspensions of petroleum in seawater. (LCL)

29417 (BNWL-1850(Pt. 2), pp 105-107) FATE AND EFFECTS OF OIL ON MARINE COASTAL ECOSYSTEMS. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Progress is reported for the first year of a study initiated to determine the impact of crude petroleum on marine communities. The initial phase of the laboratory effort was to construct a flow-through system for block exposure and to determine levels of oil and water inflow which result in lethal and nonlethal conditions for chinook salmon. Some preliminary characterization, i.e., determining the total oil content of treatment water, has been accomplished. Future studies which will be pursued to obtain and interpret biological response data are outlined. (LCL)

29418 (BNWL-SA-4919) MEASURED CHROMIUM DISTRIBUTIONS RESULTING FROM COOLING TOWER DRIFT. Alkezweeny, A. J.; Glover, D. W.; Lee, R. N.; Sloot, J. W.; Wolf, M. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 22p. (CONF-740302-1). Dep. NTIS $3.25.

From symposium on cooling tower environment–1974; College Park, Maryland, USA (4 Mar 1974).

Useful data concerning the distribution of drift from a mechanical draft cooling tower were derived from field measurements despite the non-ideal conditions which were encountered. Observed chromium fluxes ranged from about 1 mg $(m^2hr)^{-1}$ at a distance of 30 m from the tower to about 1% of that value at a kilometer. Air concentrations of chromium were fairly constant at about 50 ng m^{-3} to a distance of about 200 m downwind of the tower, apparently due to thorough mixing in the wake of the tower and a lack of lateral dilution of the effluent from a crosswind line source. A simplified droplet trajectory model appears capable of estimating drift deposition flux within an order of magnitude. Neither that model nor the experimental data are sufficiently detailed to permit definitive assessment of cooling tower drift. The proper assessment of cooling tower drift deposition for gen-

eral application would require a comprehensive investigation centered on an isolated cooling tower whose operational characteristics are well-defined and subject to control. Documentation of the drift droplet spectrum and properties of the buoyant plume and the adjacent atmosphere are essential to such an effort. (auth)

29419 (COO-3218-2) LABORATORY TESTING AND FIELD TEST SUPPORT OF THE SO_2 STACK GAS MONITOR. Final Report. 1 June 1971–31 December 1973. Pfeifer, R. J. (Industrial Nucleonics Corp., Columbus, Ohio (USA). New Ventures Div.). 31 Dec 1973. Contract AT(11-1)-3218. 33p. Dep. NTIS $4.00.

The gauge developed possesses advantages over competitive sulfur dioxide monitors. The mercury substitution and nucleonic detection (MSND) working model requires a simple sampling system and is virtually insensitive to interfering substances typically found in stack gas emissions. (LK)

29420 (K-1859) ENVIRONMENTAL ASPECTS OF COOLING TOWER OPERATION: SURVEY OF THE EMISSION, TRANSPORT, AND DEPOSITION OF DRIFT FROM THE K-31 AND K-33 COOLING TOWERS AT ORGDP. Jallouk, P. A.; Kidd, G. J. Jr.; Shapiro, T. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 74p. Dep. NTIS $5.45.

The results from a program to evaluate the environmental aspects of cooling tower operation at the Oak Ridge Gaseous Diffusion Plant (ORGDP) are presented. The quantities of chemicals being introduced into the atmosphere as well as the deposition of these chemicals on the environs surrounding the cooling towers were measured. Based on the tests performed, the cooling towers, under present operating conditions, are not causing any adverse effect on the native vegetation surrounding ORGDP. (auth)

29421 (ORNL-TM-4370, pp 288-314) WATER POLLUTION STUDIES. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

Automated, high-resolution liquid chromatographs with ultraviolet absorbance and cerate oxidation monitors are being used to analyze various polluted waters. The environmental effects of antifoulants, such as chlorine, used in cooling waters of nuclear and fossil fuel power plants are being studied. (LK)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 29603 and 31649.

General Detectors and Monitors

Refer also to abstracts 29271, 29320, 29713, 29744, 29768, 29778, 29779, 29782, 29783, 29918, 30216, 31070, 31203, 31276, 31373, and 31402.

29422 (AD-769708) RECOIL PROTON TELESCOPE FOR ACCURATE FAST-NEUTRON FLUX MEASUREMENT. Niiler, A.; Youngblood, J. E. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Jul 1973. 41p. (BRL-1657). NTIS $3.00.

A recoil proton telescope was designed, built, and tested at the Radiation Laboratory, BRL. This device is capable of absolute fast-neutron flux measurement in the energy range 2 to 20 MeV to an accuracy of better than 3%. Measurements of the telescope efficiencies at 2.60 and 14.30 MeV agree with several calculations to well within the estimated uncertainties. Thus, absolute flux measurements can be provided for the monitoring of irradiations and cross-section measurements. (auth)

29423 (AD-770603) REAL-TIME DISPLAY OF RADIATION FIELD INTENSITY DISTRIBUTION. Berardo, P. A.; Willis, J. A. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Aug 1973. 22p. (AFRRI-TN-73-10). NTIS $2.75.

A real-time display system has been designed and tested for use with a radiation field monitor. The system uses only pulse and wave-form generators, a multiplexer and an oscilloscope. The display consists of either a three-dimensional representation of the field intensity distribution or a series of simultaneous profiles. (auth)

29424 (AERE-R-7494(2nd Ed.)) MODULAR SCHEME FOR INSTRUMENTATION SYSTEMS DEVELOPMENT. Williams, D. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1974. 29p. Dep. NTIS (U. S. Sales Only) $4.50. UK 50 pence.

Reasons are given for introducing the new modular scheme (known as the Harwell 6000 series), its evolution is traced and its basic features described. Details are given of the unit families on which the systems capability of the scheme is at present based: nuclear radiation measurement, pulse counting, rate measurement, data logging, digital memory and associated units. Current development trends are indicated. (auth)

29425 (CONF-720699-P2, pp 288-299) TER POGOSSIAN CAMERA IN THE STUDY OF CARDIOPULMONARY VASCULAR KINETICS. Gongora, R.; Perdereau, B.; Gongora, G.; Jammet, H. (Institut du Radium, Paris). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The Ter Pogossian γ camera consists of three basic units: detection unit, amplifier unit, and recording unit. The characteristics of each of these are briefly described. The performance of this camera is analyzed with respect to sensitivity, respect to sensitivity, resolution, distortion, homogeneity, and useful field. Clinical scintiscanning applications for measurements of heart blood flow following administration of ^{99m}Tc-pertechnetate are discussed and illustrated. (JSR)

29426 (CONF-720699-P3, pp 422-428) COMPARATIVE STUDY OF THE BAIRD-ATOMIC IMAGER AND THE NUCLEAR-CHICAGO CAMERA. Desgrez, A.; Ribot, J.; Charreire, Y.; Nicolle, D. (CEA, Orsay, France). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The Baird-Atomic Imager is compared with the Nuclear-Chicago γ Camera for use for radioisotope scintiscanning with respect to sensitivity, homogeneity of the detection field, and ease of handling. The imager gave no gain in resolution and there were statistical corrections to be made on the homogeneity correction. The absence of spectral resolution was a serious defect and it was found difficult to operate. (JSR)

29427 (CONF-720699-P3, pp 416-420) MAGNETIC ANALYSIS AND RECORDING MINIATURIZED DEVICE FOR FUNCTIONAL STUDIED BY RADIOISOTOPES IN NUCLEAR MEDICINE. Study and Development of a Prototype. Assailly, J. (Hopital Necker, Paris); Bader, C.; Chanard, J. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A prototype of a miniaturized on-line analysis and recording assembly was developed to facilitate scintigraphic functional studies with radioisotopes. Integrated circuits and a high-performance magnetic recorder were used in the construction of the prototype. The instrument is portable as its weight is less than 2 kg. It can be used for functional studies in emergency situations in nuclear medicine. (JSR)

29428 (EGG-1183-2278) LIGHT OUTPUT OF SEMICONDUCTOR LASER MATERIALS EXCITED BY A FLASH X-RAY MACHINE. Stevens, J.; Artuso, J. F.; Klinger, Q. G. (EG and G, Inc., Santa Barbara, Calif. (USA)). Aug 1972. 26p. Dep. NTIS $4.00.

For Los Alamos Scientific Lab., NM.

A study was undertaken for the Los Alamos Scientific Laboratory to investigate the applicability of selected semiconductor laser materials as detector and dosimeter phosphors in pulsed radiation environments capable of saturating conventional liquid and plastic scintillators. Samples of cadmium sulfide, yttrium aluminate, zinc sulfide, zinc oxide, zinc selenide, and aluminum oxide in powder form were exposed in the laboratory to incident dose rates over the range of 2×10^{12} to 4×10^{14} rads/sec to test their linearity, time response, and stimulated light yield. Results indicate these light-emitting semiconductors are capable of responding to dose rates several decades above the level ($\sim 10^{11}$ R/sec) at which plastic scintillators saturate. In addition, some of these materials show a greater light output and a faster time response than plastic scintillators. (auth)

29429 (FDA-73-8029, pp 214-221) QUALITY CONTROL PROGRAM FOR CLINICAL NUCLEAR MEDICINE INSTRUMENTATION. Carey, J. E. (Univ. of Michigan, Ann Arbor). Mar 1973.

In health physics in the healing arts.

A quality control program for nuclear medicine instrumentation is described. The program consists of a regimen of basic tests and checks that will provide a reasonable assurance of proper instrument performance. The tests are simple to perform and easily incorporated into the schedule of a busy laboratory. (auth)

29430 (FDA-73-8029, pp 241-244) PORTABLE RADIATION MONITORING SYSTEM. Rossi, R. P.; Ovadia, J. (Michael Reese Hospital and Medical Center, Chicago, IL). Mar 1973.

In health physics in the healing arts.

29431 (FDA-73-8029, pp 263-266) OPERATION AND ECONOMICS OF AN INHOUSE TLD PERSONNEL MONITORING SYSTEM. Lott, S. H.; Anglin, D. R. (Vanderbilt Univ., Nashville, TN). Mar 1973.

In health physics in the healing arts.

29432 (FDA-73-8029, pp 425-429) NEW THERMOLUMINESCENT DOSIMETERS FOR X-RAY MACHINE SURVEYS AND ENVIRONMENTAL MONITORING. Rainbolt, C. (Cancer Foundation of Santa Barbara, CA). Mar 1973.

In health physics in the healing arts.

Two new thermoluminescent radiation dosimeters were developed that show promise of accurate low-level measurements for radiation protection surveys and personnel and environmental monitoring. Other characteristics include rugged construction, ease of handling, availability in lithium fluoride (for maximum tissue equivalent energy response) or calcium fluoride: Dy (for maximum sensitivity), and commercial availability. The results of characterization studies, which included reproducibility, response versus photon energy, sensibility (lowest detectable dose), and relative sensitivity are reported. (CH)

29433 (FDA-73-8029, pp 445-449) DOSE MEASUREMENT CRITERIA FOR PROSTHETIC DEVICE POWERED BY NUCLEAR BATTERIES. Smith, M. L.; Munson, L. H. (McDonnell Douglas Astronautics Co., Richland, WA). Mar 1973.

In health physics in the healing arts.

Dose measurements on prosthetic devices, such as cardiac pacemakers for implantation in humans, powered by either ^{238}Pu or ^{147}Pm can be accurately compared using a 20-liter volume of water as the scattering media with a diameter equal to the height of the cylinder. The device containing the source is located near the center of the volume. The dose can be measured using TID-100 – TLD-700 response to evaluate the neutron dose at a distance of 10 centimeters from the source. The TLD-700 response measures the gamma dose. (auth)

29434 (FDA-73-8029, pp 493-500) ROENTGENS AND ABSORBED DOSE MEASUREMENTS WITH THE RADOCON II OR CONDENSER R-METER. Bellian, J. G. Mar 1973.

In health physics in the healing arts.

29435 (INDC(NDS)-56-U, pp 9-14) REMARKS ON FLUENCE DETERMINATION BY ACTIVATION METHODS. Zijp, W. L. (Reactor Centrum Nederland, Pette, Netherlands). 1973.

From consultants' meeting on nuclear data for reactor neutron dosimetry; Vienna, Austria (10 Sep 1973).

Aspects which influence the selection of an activation detector for neutron fluence measurements are listed, and some problems and uncertainties in the measurement and data interpretation are discussed. (WHK)

29436 (INDC(NDS)-56-U, pp 37-54) REMARKS ON RESPONSE RANGES OF ACTIVATION DETECTORS. Zijp, W. L. (Reactor Centrum Nederland, Petten, Netherlands). 1973.

From consultants' meeting on nuclear data for reactor neutron dosimetry; Vienna, Austria (10 Sep 1973).

Tables are given that list the response ranges for various bare and cadmium-covered activation and fission foils. Examples are given of the neutron flux density in selected reactor cores. (WHK)

29437 (INDC(NDS)-56-U, pp 55-78) CRITICAL COMPARISON OF SPECTRUM UNFOLDING CODES. Dierckx, R. (EURATOM, Ispra, Italy). 1973.

From consultants' meeting on nuclear data for reactor neutron dosimetry; Vienna, Austria (10 Sep 1973).

Different unfolding methods of foil activation data are compared. The recommended codes are either SPECTRA (REPETE mode) or SAND II. The errors which affect the measured differential neutron flux are analyzed and estimated. (auth)

29438 (INDC(NDS)-56-U, pp 79-87) ROLE OF STANDARD NEUTRON SPECTRA IN DIFFERENTIAL FLUX DETERMINATION. Dierckx, R. (EURATOM, Ispra, Italy). 1973.

From consultants' meeting on nuclear data for reactor neutron dosimetry; Vienna, Austria (10 Sep 1973).

How the intercalibration technique in standard neutron spectra minimizes the errors on foil activation data is discussed. (auth)

29439 (INDC(NDS)-56-U, pp 89-102) METHODS FOR DETECTION OF RADIATION IN MONITORS IRRADIATED BY NEUTRONS. Czock, K. H. (IAEA, Seibersdorf, Austria). 1973.

From consultants' meeting on nuclear data for reactor neutron dosimetry; Vienna, Austria (10 Sep 1973).

For many purposes the use of threshold reactions still represents the most convenient technique for fast neutron monitoring in a reactor. The use of this type of monitor requires both a convenient method for measuring the activity induced in a sample and sufficiently accurate information concerning the cross section as a function of energy. Counting methods used in activity determinations are described. As a specific example, neutron monitoring using rhodium foils and rhodium activity determinations are described. (auth)

29440 (INDC(NDS)-56-U, pp 103-110) IMPORTANT NUCLEAR REACTIONS AND NUCLEAR QUANTITIES REQUIRED. Zijp, W. L. (Reactor Centrum Nederland, Petten, Netherlands). 1973.

From consultants' meeting on nuclear data for reactor neutron dosimetry; Vienna, Austria (10 Sep 1973).

Remarks on some nuclear data problems in relation to activation and fission foil detectors for neutron metrology are given. (WHK)

29441 (INDC(NDS)-56-U, pp 111-118) REMARKS CONCERNING CROSS SECTIONS FOR THRESHOLD DETECTORS. Liskien, H.; Paulsen, A. 1973.

From consultants' meeting on nuclear data for reactor neutron dosimetry; Vienna, Austria (10 Sep 1973).

The availability of neutron differential cross section data for activation and fission foil detectors for fast reactor neutron dosimetry is discussed. (WHK)

29442 (LA-5523-MS) LOW DEADTIME DELAY LINE READOUT FOR POSITION-SENSITIVE PROPORTIONAL COUNTERS. Anderson, A. N.; Barrett, R. J.; Wadlinger, E. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

A method is presented for circumventing the long deadtimes (25 μsec) which usually accompany the readout of helical proportional chambers and other position-sensitive detectors with delay line readout. (auth)

29443 (NP-19938, pp vp, Paper 12) TESTING AND COMPARISON OF RADIATION DETECTION INSTRUMENTS FOR THE MONITORING RADIOACTIVE CONTAMINATION OF WATER. Haberer, K.; Stuerzer, U. (Rheinwasser-Aufbereitungswerk, Wiesbaden-Schierstein, Ger.). Nov 1971. (In German).

Five types of radiation detection instruments—devices for measurement of external γ radiation and estimation of β radiation, smaller instruments with G–M tubes, devices for α and β activity measurement, meters for γ radiation, and instruments for energy measurement of γ or β radiation—are described. The reliability and efficiency of each type are evaluated. The suitability of each type for the continuous monitoring of water is discussed. The methods for evaluating the measurement results are outlined. The sensitivity of direct and indirect measurements is evaluated. (JSR)

29444 (RFP-2300) SCALER MODULES FOR RADIATION DETECTION SYSTEMS. Martin, B. E. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 28 Mar 1974. Contract AT(29-1)-1106. 17p. Dep. NTIS $4.00.

In developing radiation detection instrumentation at Rocky Flats, a system concept using plug-in modules was planned. Losses of operational time due to maintenance are drastically reduced as a malfunctioning module can be replaced within minutes. Versatility is another advantage of the modular concept and a particular module can be used in many different system designs. A significant cost savings in system development can also be realized. The scalers described are housed in one-wide Nuclear Instrumentation Bin (NIM-BIN) modules. The design incorporates the latest in COS/MOS (complementary symmetry metal-oxide semiconductor) integrated circuitry, featuring low power, low cost, and high reliability. These modules were developed specifically for radiation detection systems. Model 24370-31 is used in gross alpha detection systems. Model 27213-30 appears in a medical wound-counter system, but can be used also in a gamma spectrometer system, or in other related systems. Operational procedures and servicing of units are included. (auth)

29445 (RFP-2301) TIMER MODULES FOR RADIATION DETECTION SYSTEMS. Martin, B. E. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 29 Mar 1974. Contract AT(29-1)-1106. 18p. Dep. NTIS $4.00.

In developing radiation detection instrumentation at Rocky Flats, a system concept using plug-in modules was planned. Losses of operational time due to maintenance are drastically reduced as a malfunctioning module can be replaced within minutes. Versatility is another advantage of the modular concept and a particular module can be used in many different system designs. A significant cost savings in system development can also be realized. Two of the timers described are housed in two-wide Nuclear Instrumentation Bin (NIM-BIN) modules and a third model in a one-wide NIM-BIN module. The design uses the latest COS/MOS (complimentary symmetry metal-oxide semiconductor) integrated circuitry, featuring low power, low cost, and high reliability. These modules were developed specifically for radiation detection systems. Model 24370-21 is used in gross alpha detection systems. Model 27213-21 appears in a medical wound-counter system and the third, Model 27213-23, operates in a gamma spectrometer system. These modules can have application in other related systems as well. Operational procedures and servicing are included. (auth)

29446 (SSI-1974-10) INSTRUMENT FOR MEASUREMENT OF LOW EXPOSURE RATES. Baeckstroem, A.; Lindhe, J. C. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Feb 1974. 13p. (In Swedish). Dep. NTIS (U. S. Sales Only) $4.00.

An instrument for measurement of exposure rates between 0.1 and 20 R/h was fabricated. The instrument will be used in connection with radiation therapy of gynecologic cancer. A lithium-drifted silicon detector is used. The registered pulse information is treated in the instrument so that the exposure rate may be read directly in R/h. The instrument accumulates pulses during one second, and the repetition time is one second. The error is ±10% at 0.1 R/h, ±3% at 1 R/h and less than ±1% at 10 R/h. The repetition time may be altered to 10 sec. at calibration. This means that it is possible to measure 0.01 R/h with the accuracy 10% and 0.1 R/h with the accuracy 3%. The stability with time and temperature, linearity, energy dependence, direction dependence and lifetime was investigated. (SW)

29447 (SZS-151) PROPERTIES OF PORTABLE, BATTERY-OPERATED RADIATION PROTECTION INSTRUMENTS PRODUCED IN SOCIALIST COUNTRIES. Kraus, W.; Herrmann, D.; Schaup, K. P.; Helmstaedter, K.; Hecker, O. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Jun 1973. 39p. (In German). Dep. NTIS (U. S. Sales Only) $5.00.

Properties of battery-operated portable radiation protection instruments produced in CMEA member states are given. Their suitability for measurements of x-ray, gamma, and beta dose rates, alpha and beta surface contamination, neutron dose equivalent rate and flux density, beta and gamma contamination of liquids and finally measurements of alpha-, beta-, and gamma-active samples are discussed. The following radiation protection instruments are investigated: VA-J-10 T, VA-J-05, VA-J-105, VA-J-15 A (GDR), RUP-1, DNA-1, SOLO-VEY-2 (USSR), RUST-2

with all detectors, and RK-67 (Poland). Some of these instruments are out of production now but are still widely used in the GDR. This report gives useful information to the user and buyer of the instruments. (auth)

29448 HIGH TEMPERATURE PERFORMANCE OF IN-CORE SELF-POWERED NEUTRON DETECTORS. II. Sekiguchi, A.; Takeuchi, S.; Nakazawa, M. (Tokyo Univ.). Tokyo Daigaku Kogakubu Fuzoku Sogo Shikenjo Nenpo; 31: 163-167(Sep 1972). (In Japanese).

The performance of the double emitter type self-powered neutron detector was investigated in a high-temperature reactor core. The noise current of the detector was influenced by an irradiation history correlated with temperature and radiation intensity. Even in the worst condition of high temperature and low radiation dose, the detector was able to operate up to about 500°C. The quick response performance of the self-powered gamma detector was studied in a ^{60}Co gamma field. In a field of lower dose ($<10^5$R/hr) the output showed good linearity and stability in contrast with a gradual change in a higher dose condition. (auth)

29449 EFFICIENCY VERSUS FREON CONTENT FOR A MULTIWIRE PROPORTIONAL COUNTER HAVING 3 mm ANODE WIRE SPACING. Dieterle, B.; Heaphy, R.; Johnson, M. K. (Univ. of New Mexico, Albuquerque). Nucl. Instrum. Methods; 116: No. 1, 189-191(1974).

The efficiency of a multiwire proportional counter filled with argon, isobutane and freon 13B1 is found to depend only on freon concentration, and exceeds 99% for ≤ 0.3% freon. (auth)

29450 ABSOLUTE EFFICIENCY OF CHANNELTRON ELECTRON MULTIPLIERS FOR 10 TO 100 KeV X RAYS. Bordoni, F.; Martinelli, M.; Fioratti, M. P.; Piermattei, S. R. (CNEN, Casaccia, Italy). Nucl. Instrum. Methods; 116: No. 1, 193-194(1974).

Absolute efficiency of channeltrons has been measured in the range 8 to 100 keV x-rays. The results show that commercial CEM's may be used for diagnostic x-rays with an efficiency ranging from 1.5×10^{-2} to 4×10^{-3}. (auth)

29451 FORMATION OF THE TOMOGRAPHIC IMAGE: WITH SPECIAL REFERENCE TO BLURRING. Mattsson, O. Acta Radiol., Suppl.; No. 318, Suppl., 1-58(1972).

The ability of the usual types of tomographic systems to produce blurring of detail from adjacent object planes is analyzed experimentally and mathematically. The further development of tomography must be dependent on a better understanding of its character. Different tomographic movements have been compared and certain possible technical errors that may deteriorate the blurring as well as other disturbing factors influencing the tomographic result are discussed. The distribution of exposure intensity within the transitional zone represents the blurring effects on contours and makes possible a graphical comparison of different systems. The principles of obtaining optimal effects of blurring are considered and a method is presented that utilizes a combination of tomograms of the same plane produced by different movements. A special copying technique preserves and collects valuable detail but reduces disturbing and irrelevant elements. (auth)

29452 NUCLEAR RADIATION MEASUREMENTS. II. Industrial Unit. Marin, B. H. Elec.-Electron. Mod.; No. 277, 42-51(Nov 1973). (In French).

An independently operating and portable industrial polyradiometer, IPAB-71, intended for health physics radiation measurements is described. The apparatus was designed to measure α, β, and γ contamination as well as dose rates (mrad/h). The theory of the operation of the apparatus is presented. (FR)

29453 INVESTIGATION OF THE NEUTRON DETECTION EFFICIENCY OF A PLASTIC SCINTILLATION DETECTOR IN THE ENERGY RANGE 6 TO 41 MeV. McNaughton, M. W.; Brady, F. P.; Broste, W. B.; Sagle, A. L.; Johnsen, S. W. (Univ. of California, Davis). Nucl. Instrum. Methods; 116: No. 1, 25-28(1974).

Measurements of ±3% accuracy are reported of the detection efficiency of a 15.2 cm thick NE102A plastic scintillation detector in the energy range 6 to 41 MeV, for thresholds of 1.0 and 4.2 MeV. The results are compared with the predictions of two computer codes, and significant discrepancies of up to 20% are observed. The variation of efficiency across the face of the detector has been measured and differences of about 10% (relative) observed between centre and edge of 7.1 cm diameter cylinder. (auth)

29454 FILTERS FOR USE IN PULSE-AREA SENSING SYSTEMS. Connelly, J. A.; Pierce, J. F. (Univ. of Tennessee, Knoxville). Nucl. Instrum. Methods; 116: No. 1, 85-92(1974).

Variation of the charge collection time normally associated with semiconductor p–n junction detectors degrades the resolution of both peak-amplitude and pulse-area measuring systems. However, the specific amount of degradation depends upon the particular measuring system used and upon the filter network chosen. The results discussed in an earlier paper are used in this study to demonstrate the existence of a general class of filter networks suitable for area sensing. The specific magnitude of resolution error for evaluating practical systems employing single RC differentiation and RC–CR filters is available from the included graphs. A comparison between peak-amplitude and pulse-area sensing techniques based upon equal resolution errors is included for the RC, RC–CR, and delay-line filters. This comparison demonstrates the superiority of particular filters for pulse shaping within various ranges of collection times and filter time constants. (auth)

29455 FAST AND STABLE LOGARITHMIC CONVERTER EMPLOYING RESISTANCE MATCHING. Ohkawa, S.; Husimi, K. (Tokyo Univ.). Nucl. Instrum. Methods; 116: No. 1, 71-75(1974).

A log-converter is described which uses a simple series circuit of a log-diode and a resistor, and is particularly advantageous for speeding up the output response. The relations concerning the characteristics of the log-diode and the resistor are studied for the purpose of extending the dynamic range of this log-converter. This log-converter is designed to perform an arithmetic operation necessary for identifying particles using the solid state detector telescope. (auth)

29456 ANALOG PARTICLE IDENTIFIER WITH A WIDE DYNAMIC RANGE OF THE E/ΔE RATIO. Ohkawa, S.; Husimi, K. (Tokyo Univ.). Nucl. Instrum. Methods; 116: No. 1, 61-69(1974).

A particle identifier which has a good performance for a wide range of signal ratio E/ΔE has been developed based on the multiplication type formula approximating the Goulding equation. The purpose of this approximation is to utilize an analog summation technique (logarithmic) instead of the analog subtraction circuit, since the performance of the subtraction circuit is one of the limiting factors of the dynamic range, especially when the ΔE signal is small while the E signal is large. The numerical method used for deriving the good approximation formula is also applied to the analyses of the problems of the particle identification. (auth)

29457 SIMPLE PULSE-SHAPE DISCRIMINATION CIRCUIT. Sperr, P. (Technische Univ., Munich); Spieler, H.; Mier, M. R.; Evers, D. Nucl. Instrum. Methods; 116: No. 1, 55-59(1974).

A simple pulse-shape discrimination circuit is described. Some results are presented for NE213 organic liquid scintillators of different sizes. The influence of the lower threshold energy and the effect of high counting rates on the pulse-shape discrimination properties are shown. Complete rejection of gammas is obtained for a small scintillator (2'' diam. × 1'') even for electron energies down to 0.2 MeV. (auth)

29458 NEUTRON-DETECTOR EFFICIENCY MEASUREMENTS FROM 7 TO 14 MeV. Leleux, P.; Macq, P. C.; Meulders, J. P.; Pirart, C. (Institut de Physique Corpusculaire, Louvain-la-Neuve, Belgium). Nucl. Instrum. Methods; 116: No. 1, 41-43 (1974).

The neutron efficiency of an NE 102 plastic scintillator is measured for neutron energies from 7 to 14 MeV, using the D(d,n)^{3}He reaction. The experimental results are compared with the predictions of two program codes. Different values of the ^{12}C(n,α)^{9}Be reaction cross sections are introduced in the calculations; they strongly affect the calculated efficiency. (auth)

29459 FAST- AND EPITHERMAL-NEUTRON FLUX MEASUREMENT. Lavi, N.; Fisheizon, Z. (Soreq Nuclear Research Centre, Yavne, Israel). Nucl. Instrum. Methods; 116: No. 1, 123-124(1974).

The feasibility of applying fission-produced ^{140}Ba to determine fast- and epithermal neutron fluxes was investigated experimentally. ^{140}Ba decays by beta-ray emission with a half-life of 12.8 d to ^{140}La. The absolute activity of ^{140}La calculated from the measured activity of the 1596.2 keV peak with a calibrated Ge(Li) detector was obtained from two uranium samples differing in their ^{235}U percentage irradiated under cadmium cover. The solution of two simultaneous equations was used to determine the epithermal- and fast-neutron fluxes. (auth)

29460 DETERMINATION OF THE EFFICIENCY OF Ge(Li) DETECTORS NEAR THE GERMANIUM K EDGE. Rosner, B.; Gur, D. (Technion-Israel Inst. of Tech., Haifa). Nucl. Instrum. Methods; 116: No. 1, 171-172(1974).

The determination of the efficiency curve of Ge(Li) detectors near the germanium K edge by the K_α/K_β X-ray intensity ratio is discussed. It turns out that the use of arsenic X rays emitted by fluorescence from a GaAs crystal as suggested by Forcinal causes a small error due to the different functional dependence of the photoelectric absorption coefficient just below and above

the absorption edge. This alters somewhat the K_α/K_β ratio as compared to As metal. (auth)

29461 RELATIVE EFFICIENCY OF A THIN Ge(Li) DETECTOR NEAR THE K ABSORPTION EDGE OF Ge. Scott, R. D. (Scottish Universities Research and Reactor Centre, Glasgow). Nucl. Instrum. Methods; 116: No. 1, 173-175(1974).

A simple method of determining the relative efficiency of thin Ge(Li) x-ray detectors in the vicinity of the K absorption edge of Ge is given. (auth)

29462 ECCENTRICITY EFFECTS IN THE ABSOLUTE DETERMINATION OF α-EMITTERS WITH LOW GEOMETRY COUNTERS. Kempf, W. Munich; Univ. Munich (1970). 109p. (In German).

Thesis.

One of the most essential devices for the absolute counting of α-particles emitted by alpha-active substances is the low geometry counter. In this device, the α-particles emitted by the sample pass the collimator aperture and are counted by an appropriate detector, with the sample and collimator being arranged coaxially, as a rule. Thus, a direct relationship can be determined by means of a fairly accurately definable geometry factor between the counting rates and the absolute activity of the sample. Displacing the sample laterally will result in a change in counting rates. The purpose of this work was to study the eccentricity effects due to such displacements. A counting device has been set up which permits reproducible radial displacement of the samples and measurement. Furthermore, the corresponding mathematical formulation of the modified theory of the low geometry counter (geometry factors) is developed anew and numerically verified. The preparation of ^{241}Am samples by electrolytic deposition is described in detail. (GE)

29463 LARGE-AREA SILICON SEMICONDUCTOR DETECTOR TELESCOPE FOR IDENTIFICATION OF PRIMARY COSMIC-RAY ISOTOPES. Nakagawa, S. (Rikkyo Univ., Tokyo); Tsukuda, M.; Okudaira, K.; Hirasima, Y.; Yoshimori, M.; Murakami, H. Nucl. Instrum. Methods; 116: No. 2, 297-300(1974).

Large-area silicon semiconductor detectors with an effective area of 20 cm^2 have been fabricated to observe primary cosmic ray isotopes from hydrogen to oxygen with a high resolution. As a priliminary experiment the energy resolution of detectors was investigated for α particles and internal conversion electrons. A detector telescope consisting of ΔE and E detectors was constructed and the mass resolution of the detector telescope was investigated by measuring long-range ^{1}H, ^{2}H and ^{3}H nuclei emitted from the radioactive ^{252}Cf source. The expected result was obtained from this preliminary experiment and it seems possible to separate masses of primary cosmic ray isotopes up to oxygen with a high resolution. (auth)

29464 TIME COMPENSATOR FOR LARGE SCINTILLATION COUNTERS. Faust, J.; Larsen, R. S. (Stanford Univ., CA). Nucl. Instrum. Methods; 116: No. 2, 365-368(1974).

A circuit is described which develops time-invariant pulses for large scintillation trigger counters. For a 8.56 ft long counter, a unit capable of ±22 ns range is described; the constancy of delay of output for this unit over the full delay range is typically ±400 ps. (auth)

29465 ON-LINE DATA PROCESSING OF GAMMA CAMERA IMAGE USING USC-1 SYSTEM. Matsumoto, M.; Hirota, Y.; Tateshi, K.; Yasunaga, T. (Kumamoto Univ., Japan). Kaku Igaku; 10: No. 6, 539-547(Dec 1973). (In Japanese).

The gamma camera is widely used to measure the distribution of radioisotopes in the body, but the image itself is inferior in quality. This fact depends upon various factors, e.g., nonuniformity of the sensitivity and the limitation of resolution of the detector, and statistical fluctuation of the radioactivity. Various methods of data processing of the image data from a gamma camera using the digital computer are under development in order to obtain information for the clinical diagnosis. The analysis and display by the USC-1 data processing system for radioisotope image by delay-line gamma camera (GCA-102) are described. This system is composed of 4K core memories, twin ADC, data control unit, MT recorder, PT puncher PT reader, digital printer, XY recorder and CRT display, and is connected on-line with the gamma camera. This system is the wired program computer, so that all memories are used to store the isotope image, and the processing time is rapid, compared to the case of using another minicomputer. Many methods of image processing are done by this system: calibration of isocount levels, digital data threshold, three dimensional display, contrast enhancement, profile histogram, smoothing, subtraction, and dynamic histograms on a regional area of interest. (auth)

29466 THICKNESS AND UNIFORMITY OF THE SENSITIVE AREAS OF SILICON DETECTORS. Alekseev, N. V.; Burymov, E. M.; Vakulov, P. V.; Denisov, Yu. I.; Yurchenko, Zh. D. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 603-610(1973). (In Russian).

A method is described for the investigation of the thickness and uniformity of the sensitive areas of a series of Si semiconductor detectors of Soviet and foreign manufacture and the results are reported. A comparison was made of the measurement accuracy and reliability by different methods which exist for quality control of the detectors under industrial and laboratory conditions. (tr-auth)

29467 OPTICAL TRANSMISSION MEASUREMENTS ON MONOCRYSTALLINE AND POLYCRYSTALLINE CESIUM IODIDE. Viehmann, W. (Goddard Space Flight Center, Greenbelt, MD); Arens, J. F.; Simon, M. Nucl. Instrum. Methods; 116: No. 2, 283-295(1974).

Optical transmission measurements in the visible wavelength region have been made on commercial monocrystalline and polycrystalline cesium iodide in order to characterize quantitatively the optical quality of presently available state-of-the-art material and to define and measure parameters which determine its performance in large-area scintillation counters for which the light-collection efficiency depends primarily on multiple internal reflections within the scintillator crystal. Losses associated with surface scattering, volume scattering and scattering under total internal reflection were determined on CsI crystals whose surface had degraded as a result of prolonged storage in ambient atmosphere, on newly polished material and on highly polished samples encapsulated with lucite and silicon oil. For blue (λ = 425 nm), normally incident light, scattering losses per surface are typically of the order of 30% to 40% for degraded material, 20% to 25% for newly polished material and 5% to 10% for well-polished, encapsulated crystals. Volume losses are mainly due to scattering, although absorption bands indicative of color centers were observed in some samples. Considerable variations in volume absorption length were observed from sample to sample as well as within individual samples, with absorption lengths ranging from 500 cm to 20 cm at λ = 633 nm. Scattering losses per reflection in the total internal reflection mode are generally higher by a factor of 1.5 to 2 than those measured under normal incidence. Scattering coefficients decrease with increasing wavelength, approximately proportional to λ^{-1}. Presently available polycrystalline CsI is substantially inferior in surface quality to single-crystal material, particularly in samples of large dimensions. For large-area CsI modules utilizing total internal reflection for light collection and requiring a high degree of spatial uniformity of response, carefully selected single-crystal material of good optical quality is essential. (auth)

29468 SHAPE OF THE PHOTOPEAK IN A NaI(Tl) SCINTILLATION DETECTOR. Mudhole, T. S.; Umakantha, N. (Karnatak Univ., Dharwar, India). Nucl. Instrum. Methods; 116: No. 2, 401-403(1974).

The shape of the photopeak due to the 622 keV line of ^{137}Cs was studied using a NaI(Tl) scintillation detector. The higher-energy part of the photopeak is found to be a Gaussian, even at high counting rates. (auth)

29469 INSTALLATION FOR MEASURING THE ANGULAR CORRELATION BETWEEN AT LEAST TWO PARTICLE EMISSIONS FROM A RADIOACTIVE SAMPLE. Gervais, R.; Peretto, P. (to Commissariat a l'Energie). French Patent 2,129,853. 17 Mar 1971. 13p. (In French).

An installation is described for measuring the angular correlations between at least two particle emissions from a radioactive sample. The installation utilizes a horizontal rotating circular table upon which several detection and direction measuring assemblies are mounted. The positions of these assemblies can be adjusted with respect to the radius of the table, the assemblies making given angles with this radius. Means are provided for commanding the rotation of the table and for modifying the orientation of the measurement assemblies. The lower base is parallel with the table and provided with a bracket which supports a cryostat positioned vertically above the table. The bottom part of this cryostat contains the radioactive sample to be examined. Means are also provided for accurately centering the cryostat along the axis of the table and for regulating the height of the detection assemblies in relation to the sample contained in the cryostat. (FR)

29470 TIME-DIFFERENTIAL PERTURBED ANGULAR CORRELATIONS AND THE RECOIL-DISTANCE METHOD. Hagemeyer, K. (Univ., Bonn). Nucl. Instrum. Methods; 116: No. 2, 397-400(1974).

Perturbed angular correlations can be studied time-differentially

in the picosecond–nanosecond range using the recoil-distance method. It is shown how true time-differential as well as half-integral attenuation factors may be obtained by observing the angular correlation at three angles, one of them being 90°. (auth)

29471 DEGRADATION OF POLYMERS IN SCINTILLATOR SOLUTION. Norris, J. F.; Peaker, F. W. (Univ. of Birmingham, Eng.). Int. J. Appl. Radiat. Isotop.; 25: No. 3, 143-144(Mar 1974).

It is reported that partial degradation of high polymers takes place when subjected to liquid scintillation counting. Significant degradation was only observed in the fractions of highest molecular weight. The cause of degradation is uncertain though photochemical degradation appears to be the most probable mechanism. (UK)

29472 GAMMA CAMERA ACTIVATED TO BE RESPONSIVE TO SELECTED LEVELS OF LIGHT EMISSION. Mallard, J. R.; Mitchell, J. G.; Wilks, R. J. (to National Research Development Corp.). US Patent 3,793,519. 19 Feb 1974. Priority date 21 Apr 1971, United Kingdom of Great Britain and Northern Ireland. 4p.

The invention concerns apparatus for use in investigating the distribution of radiation from an extended source of ionizing rays and is particularly concerned with gamma cameras for sensing gamma radiation. In normal gamma cameras, due to the long exposure time, the sensitivity of the camera is reduced by spurious light emission from the scintillation screen. In the present invention the effect of this spurious emission is reduced by only triggering the image intensifier in response to predetermined values of light emission. This predetermined triggering is achieved by collecting the unwanted light emitted at the edges of the scintillation screen and directing this into one or more photomultipliers, the outputs of which are taken to a pulse height analyzer which is used to trigger the image intensifier. (Official Gazette)

29473 RADIATION MEASURING SYSTEM UTILIZING A CHARGE SENSITIVE AMPLIFIER. Foote, R. S. (to Geodata International, Inc.). US Patent 3,797,802. 19 Mar 1974. Filed date 21 Jan 1972. 6p.

The method and apparatus for measuring pulsed electric charges, such as the charges from a radiation detection device, which charges originate at a point remote from the place of measurement, including transmitting the charges from their source to the place of measurement, amplifying the charges with a charge sensitive preamplifier and measuring the characteristics of the charges is described. (Official Gazette)

29474 RADIATION DETECTION SYSTEM WITH FAIL SAFE FEATURE. Linner, L. R. (to Honeywell Inc.). US Patent 3,790,800. 5 Feb 1974. Filed date 27 Dec 1972. 6p.

An internal ionization radiation sensor operates to discharge a capacitor in the presence of incident radiation. The recharging current is sensed by a threshold output device. In one embodiment, the threshold output device is prevented from receiving the additional current necessary to be triggered if the radiation sensor fails in the runaway mode. The additional current to trigger the threshold output device is supplied from a second capacitor which is prevented from charging by a runaway radiation sensor. (Official Gazette)

29475 RADIOACTIVITY MONITORING APPARATUS FOR FLUIDS IN FLOW. Hunt, D. O. (to Lee Corp.). US Patent 3,790,804. 5 Feb 1974. Filed date 1 May 1972. 8p.

Unusually high sensitivity is obtained in a radioactivity monitor for fluid in flow by blocking external background "noise" with four pi shielding, minimizing residual contamination as a source of internal noise with a dynamic swirl in a removable bowl-shaped container having a smoothly curving surface passing into a bottom outlet, and providing a constant sampling volume by maintaining an external fluid level above that of the container and by venting through the top of the container. (Official Gazette)

29476 TOPOGRAPHIC RADIOISOTOPE CAMERA HAVING AN ADJUSTABLE COLLIMATOR THEREON. Inoue, M.; Ishimatsu, K.; Tabuchi, H. (to Hitachi, Ltd.). US Patent 3,790,782. 5 Feb 1974. Priority date 25 Mar 1968, Japan. 16p.

A radioisotope camera is described that may be adapted to detect radioisotopes on a particular tomographical plane exclusively with high accuracy and high resolution, comprising a multi-hole parallel collimator formed into a special form and a gamma ray detector coupled to the collimator to be movable with respect to the tomographical plane. (Official Gazette)

29477 COLLIMATOR PARTICULARLY FOR HIGH RESOLUTION RADIOACTIVITY DISTRIBUTION DETECTION SYSTEMS. Grenier, R. P. (to Baird-Atomic, Inc.). US Patent 3,793,520. 19 Feb 1974. Filed date 27 Jan 1972. 10p.

Radiation emitted from a subject positioned on a programmable X, Y platform is directed through a multiplane focused collimator and is detected by means of an array of sensing devices. The collimator comprises a registered stack of photoetched plates, each plate formed with a series of hole sets and each stack of hole sets defines downwardly converging collimator bores. One hole set is distinguished from another hole set by different hole profiles, each hole profile defining a specific local length. The platform, which is in spaced relationship with the collimator, is moved incrementally along its X and Y axes in steps defining a programmed scanning pattern, each step being an integral multiple of the distance between adjacent sensing devices. The number of radioactive events detected at each step is temporarily held in a buffer memory and then applied to a digital data storage unit in a computer. Upon completion of the programmed scanning sequence, the stored data, which represents the radioactivity detected at various depth of the subject, is applied to a display for presentation as a composite half tone pictorial representation of the detected radioactive events. (Official Gazette)

29478 INSTRUMENTS IN THE FIELD: USE, ABUSE, AND MISUSE. Kathren, R. L. (Battelle Pacific Northwest Labs., Richland, WA). pp 811-823 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

Great advances in field instrumentation have been made over the past decade, providing the operational health physicist with a powerful armamentarium. However, even the most modern instruments have many limitations, and measurements must be made and evaluated in the light of these limitations, which include energy and angular dependence, response to pulsed sources, and effects of mixed radiation fields. The concept of surface dose rate, its meaning, use, and misuses are examined in the context of operational health physics. A practical method of measuring doses close to the source–air interface is discussed. (auth)

29479 EVALUATION PROGRAM FOR PORTABLE RADIATION MONITORING INSTRUMENTS. Zuerner, L. V.; Kathren, R. L. (Battelle Pacific Northwest Labs., Richland, WA). AT (45-1)-1830. pp 825-850 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

Knowledge of response and performance capabilities is of practical importance in selection and use of radiological measuring devices for health physics purposes. Instruments are desired which will meet prescribed performance specifications with the lowest overall cost per unit of time. In some cases, a high initial cost will be more than offset by lower operating and maintenance charges. A well oriented and directed evaluation program should examine appropriate physical, electronic, and radiological characteristics of the instrument, providing data for performance and cost analysis. For portable instruments, weight, strength, and ease of handling and servicing are important physical characteristics. Human engineering features such as ease of meter reading, availability of controls, and physical stability must also be considered. Among the electronic features to be considered are sensitivity, temperature and voltage dependence, stability, battery lifetime, response to electrical interference, noise and vibration, and extracameral radiation. Radiological factors include accuracy and stability of calibration, energy dependence, response to unwanted radiations, temperature dependence, and saturation effects. A typical evaluation program is outlined for portable radiation survey meters and recommendations made for a standardized system of determining and reporting instrument performance. (auth)

29480 PLUTONIUM SURVEY WITH AN X-RAY SENSITIVE DETECTOR. Tinney, J. F.; Koch, J. J.; Schmidt, C. T. (Univ. of California, Livermore). pp 851-875 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

Traditionally, plutonium surveys have been conducted with alpha-sensitive detectors. More recently, however, x-ray detectors have been developed for this purpose. The design and performance of the low-energy x- and gamma-ray detector developed at LRL for plutonium survey are described. Presented also are the results of a plutonium survey conducted under field conditions with this detector and a conventional alpha survey instrument. (auth)

29481 MULTIPURPOSE RADIATION MONITORING SYSTEM. Owen, F. E. (Douglas United Nuclear, Inc., Richland, WA). pp 877-893 of Health Physics Operational Monitoring. Vol. 2. Willis,

C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

A radiation monitor for use at the Hanford Production Reactors is described. The multipurpose system features dual alarms; an audible radiation emergency alarm that can be activated by a very high dose rate and a visual radiation control alarm that is triggered by a nominal but unplanned increase in working dose rates. The system is particularly valuable for radiation monitoring during charging or unloading of the reactors. (TFD)

29482 WALK-OVER MONITOR FOR ALPHA AND BETA-GAMMA CONTAMINATION. Splichal, W. F. Jr. (E. I. du Pont de Nemours and Co., Aiken, SC). Contract AT(07-2)-1. pp 911-924 of Health Physics Operational Monitoring. Vol. 2 Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

A walk-over hand and shoe monitor was developed to quickly screen personnel for alpha and beta-gamma contamination when leaving a regulated work area. A walk-over bridge monitor was selected because it is easy to use and therefore is readily accepted by personnel, and it also allows a large number of employees to be monitored quite rapidly which is particularly important at shift changes. Other walk-over or walk-through personal contamination monitors have been reported, but none monitored for alpha, as well as beta-gamma contamination. The monitor allows 60 people per minute to be checked, which is considerably faster than conventional stand-on monitors. Approximately 4×10^3 dis/min of alpha, 1.6×10^4 dis/min of ^{204}Tl(0.77 MeV beta), or 2.2×10^5 dis/min of ^{54}Mn (0.84 MeV gamma) on hands or shoes of a person walking across the monitor at a normal pace triggers an alarm. (auth)

29483 CALIBRATION AND FIELD USE OF IONIZATION CHAMBER SURVEY INSTRUMENTS. Howell, W. P.; Kathren, R. L. (Battelle Pacific Northwest Labs., Richland, WA). pp 925-938 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

The measurement accuracy of ion chamber survey instruments in field survey situations is affected by both the calibration procedures and the geometric relationship between the radiation source and the chamber. The fundamentals of the calibration method used at Hanford for ion chamber instruments and the resulting capabilities of the instruments in field survey situations are described. Additional corrections to calibrated instrument results are ordinarily required when measuring small beams, radiation fields associated with large beta sources, and radiation levels where the chamber is in contact with the source. The method of determining the required corrections, and the values of the correction factors are described for one widely-used CP ion chamber survey instrument. (auth)

29484 LIVE TIME CONTROLLED SCANNING RATE FOR A WHOLE BODY COUNTER. Sveum, M. E.; Bramson, P. E. (Battelle Pacific Northwest Labs., Richland, WA). pp 951-958 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

Scanning whole body counters tend to sacrifice sensitivity and introduce measurement error through the use of constant drive rate mechanisms which do not readily compensate for excessive electronic dead time or subject height. An electronic drive rate control has been developed at Battelle-Northwest Laboratory which largely eliminates these problems. The control is easily programmed for subject height and count duration and to automatically adjust the relative drive rate to compensate for multichannel analyzer dead time. Digital circuitry, utilizing integrated circuits, controls the speed of a heavy duty stepping motor by controlling the motor stepping frequency. (auth)

29485 AUTOMATIC CONVEYOR TYPE LAUNDRY ALPHA-BETA-GAMMA CONTAMINATION MONITOR. Sheen, E. M.; Crouch, G. D. (Battelle Pacific Northwest Labs., Richland, WA). Contract AT(45-1)-1830. pp 959-969 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

An automatic radiation monitoring system was developed by the Pacific Northwest Laboratory for the Federal Support Services of International Telephone and Telegraph to scan laundered protective clothing and automatically reject contaminated garments. This system employs two stainless steel wire belt conveyors that transport the wearing apparel at a belt speed of 160 in./min between two large alpha-beta-gamma scintillation detectors that simultaneously monitor upper and lower surfaces of each item of apparel for alpha-beta-gamma contamination. The instrument reliably sorts items for further decontamination if they are contaminated to a level greater than the equivalent of 25,000 dis/min (11 nCi) of Ra DEF or 1000 dis/min (0.45 nCi) of 5-MeV alpha emitters distributed over 100 cm^2. (auth)

29486 NEUTRON ACTIVATED CRITICALITY ALARM SYSTEM. Zuerner, L. V.; Weddle, R. C. (Battelle Pacific Northwest Labs., Richland, WA). Contract AT(45-1)-1830. pp 971-980 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

A system incorporating BF_3 type neutron detectors has been designed and is now in use at the Pacific Northwest Laboratory. The monitors have been calculated to alarm to a pulsed fast neutron dose of 50 micro-rem. They have been successfully tested under simulated criticality conditions with a 50 micro-second burst from a pulsed reactor. The alarm is activated when a preset count rate is exceeded. Alarm time is less than 0.5 seconds when the count rate from neutrons exceeds the alarm set point count rate by 5%. Basic sensitivity is determined by the type of BF_3 tube used; the instrument can be adjusted to alarm in fast neutron fields of 20 to 1000 mrem/hr. The signal from the polyethylene moderated BF_3 tube is amplified, shaped and fed to an integrating capacitor in a voltage sensitive trip circuit. This circuit activates the criticality alarms. Failure alarms are energized by circuits which detect high or low operating voltages and loss of signal from the neutron circuits. A self-auditing operating feature is designed around random input from background radiation. The criticality alarms are operated in a "2 out of n system." Two monitors must be in the alarm condition before an evacuation alarm is sounded. This minimized false alarms caused by local high level gamma fields, electromagnetic interference, and other spurious signals. (auth)

29487 USE OF A DIFFERENTIAL VOLTAGE COMPARATOR AS AN ALARM LEVEL CONTROL. Chester, J. (Brookhaven National Lab., Upton, NY). pp 995-1004 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

The purpose of most fixed radiation monitoring instruments is to provide an alarm when the radiation levels being monitored exeed a predetermined value. It is therefore necessary to provide reliable alarm circuitry if the primary instrument is to be effective. Although meter relays are the most common alarm level controls now in use they have several limitations. Contact type relays prevent the indicating meter from exceeding the alarm set point and they are limited to only one up-scale point and one down-scale point. The non-contact type meter relay is expensive and in both types the alarm level can only be set at the indicating instrument. The disadvantages of the meter relay can be overcome by using a differential comparator in the form of an integrated circuit which is small, reliable and inexpensive. It can be connected to operate with either a positive or negative signal. The alarm level control can be set accurately and is stable over long periods of time. The control can be located on the primary indicating instrument or at any remote location. The circuit requires so little power from the indicating instrument that several alarm points can be used. The circuit is wired in a fail-safe manner in that any failure of the indicating instrument, the differential comparator, or any other component will result in an instrument failure alarm. Alarm circuits using Fairchild μA 710 differential comparators have been in use at Brookhaven's High Flux Beam Reactor air monitoring system for over a year without failure. (auth)

29488 MEASUREMENT OF ^{41}Ar EFFLUENT FROM UNIVERSITY-SIZE REACTORS. Meck, R. A. (Univ. of California, Berkeley). pp 1029-1042 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

A sensitive ion chamber-electrometer system has been shown to be a simple and direct method for measuring the argon-41 effluent from a TRIGA-III reactor. The advantages of this method of measurement include the ability to measure the effluent due to very rapid reactivity pulses and to continuously monitor less than the maximum permissible concentration for argon-41 in air ($<4 \times 10^{-8}$ μCi/cc.) Data are compared to those of similar reactors. (auth)

29489 TWO-FILTER METHOD FOR RADON-222. Thomas, J. W.; LeClare, P. C. (Atomic Energy Commission, New York). pp 1107-1116 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

The two-filter method for radon-222 has been improved so that it is rapid and simple, requiring only ordinary alpha counting. Radon containing air is passed through two filters in series separated by a known cylindrical volume V. The first filter passes radon but removes all daughter activity. The second filter collects daughter products formed in flight in the volume V. The activity of radon (C_{Rn}) in picocuries per liter is given by $(0.450X)/EZVF_f$ where X is the number of alpha counts on the exit filter for a given sampling time and counting time, E is the counter efficiency, Z a decay correction factor, and F_f the fraction of radium-A atoms formed in V that arrives at the exit filter. Tables of Z for various sampling and counting times have been developed. Likewise, values of F_f are given from solution of the equation for diffusion in a cylindrical tube with formation in flight. Derivation of these Z and F_f factors makes the method absolute and theoretically no calibration is required. The sensitivity of the method is of the order of a few picocuries per liter for sampling and counting times of about 15 minutes and a tube volume of ½ liter. Much higher sensitivities are possible for large tube volumes and long sampling and counting times. (auth)

29490 PLUTONIUM SENSITIVE ALPHA AIR MONITOR. Nichols, C. E. (Idaho Nuclear Corp., Idaho Falls). pp 1117-1125 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

A plutonium sensitive alpha-air monitor, utilizing two ZnS scintillation detectors, has been developed at the Idaho Nuclear Corporation Health and Safety Laboratory that will detect plutonium-239 in the presence of the most adverse natural activity atmospheres found within the National Reactor Testing Station. The instrument, without the use of discriminators, has demonstrated that it can eliminate greater than 90% of the 2,250 d/m alpha natural background activity collected in order to detect 48 RCGs of soluble Pu-239 within 1½ hours. With the use of discriminators, the instrument should be able to detect even lower concentrations of plutonium-239. (auth)

29491 AIR MONITORING AND ITS EVOLUTION AT THE LASL PLUTONIUM FACILITY. Valentine, A. M.; Meyer, D. D.; Romero, W. F. (Los Alamos Scientific Lab., NM). pp 1127-1145 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

A program to monitor airborne contamination in the working environment of a plutonium facility is discussed. Only those aspects most closely associated with operational monitoring are included and, as a result, several side topics in the realm of air monitoring are not mentioned. Techniques, equipment, records, and philosophy are discussed, in addition to air concentration trends, equipment evolution, cost, manpower requirements, and inherent shortcomings. For the present air monitoring program, 351 samples are collected daily on HV-70 filters at fixed locations in work areas and counted in automatic alpha counting systems. Counting results are interpreted in terms of air concentrations and recorded for evaluation by the health physics and operating staff. Also, 21 commercial continuous air monitoring devices are located throughout the work areas. (auth)

29492 AUTOMATIC INCREMENTAL AIR SAMPLER. Marquiss, R. P. (Naval Radiological Defense Lab., San Francisco, CA). pp 1147-1157 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

An automatic incremental air sampler has been developed to sequentially assess the concentration of airborne radioactivity associated with a continuing series of experiments with short-lived early time ^{235}U fission products. Essential characteristics of the sampler are: (1) continuous automatic incremental operation, (2) inexpensive GM detectors, (3) selectable sampling intervals, (4) selectable decay counting intervals, (5) digital scaling and print-out, and (6) "portability" and remote sampling characteristics. Examples of the use of this unit and some suggested improvements are presented. (auth)

29493 CRITICALITY DETECTION SYSTEM: A PLEA FOR CURRENT CRITERIA. Denham, D. H.; Selby, J. M. (Battelle Pacific Northwest Labs., Richland, WA). pp 1755-1765 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Comparison of existing criticality detection system criteria and regulations to criteria and regulations for other phases of the nuclear industry is rather startling. USASI has developed a standard on an evacuation signal but has not developed a standard on a criticality detection system. The regulatory organization of the AEC requires, in 10 CFR 70, the use of criticality detectors but provides little guidance on the requirements for such a system. The guidance provided in AEC Manual Chapters for AEC contractors is even less than that for the licensee. Several papers on criticality accidents, which have been reported in the Health Physics Journal, mention the role that criticality detectors played in alerting personnel. However, none of these contain recommendations for such a system. The existing standards for criticality detection systems and the regulations governing their use are discussed. The evolution of a fail-safe neutron criticality alarm system at Battelle–Northwest, with capabilities that surpass the existing regulations, is described. New standards which have been proposed will provide better guidance for criticality detection systems. Results of tests of the system's components are compared to illustrate the practicability of meeting the new proposed standards. (auth)

29494 ELECTRON-BEAM STUDIES OF SCHOTTKY-BARRIER DETECTOR SURFACES. Peckerar, M. C. (Goddard Space Flight Center, Greenbelt, MD). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 383-387(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The electron beam technique used by Czaja to analyze defects in diode structures has been applied to the analysis of surface anomalies occurring in Schottky-barrier particle detectors. An output map of the detector surface showing local variations in sensitivity was obtained in this manner. It was discovered that characteristic anomalies give characteristic displays. Specifically, SEM analysis was useful in detecting: chemical contamination of the detector surface; mechanical damage of the detector's semiconductor wafer substrate; damage introduced in semiconductor surface preparation; radiation damage; and defective surface metallization. The possibly damaging effects of scanning electron beam irradiation are discussed. A general limit on beam current and magnification setting for a 20 keV beam is given. If this limit is not exceeded, the technique does not, in itself, add artifacts to the electron beam technique display. Methods are developed which enable the quantification of the extent and severity of surface damage. How these methods can be used to eleminate some common processing problems is also covered. (auth)

29495 PROCESS AND DEVICE FOR DETERMINING RADIOISOTOPES. Friel, H. I.; Prag, R.; Schlichting, H. (to Siemens Aktiengesellschaft). US Patent 3,790,786. 5 Feb 1974. Priority Date 10 Apr 1971, F. R. Germany. 6p.

A process and device for ray diagnosis are used to determine the distribution of radioactive isotopes located in a body by a line by line feeling of a measured surface through which the rays pass. The feeling takes place by means of a measuring probe which changes the intensity distribution into a sequence of impulses which are summed up one after the other through adjustable partial lengths of image rows in an integration counter combined with an inscribing device operated by the sums of impulses to provide an image reproducing the intensity distribution. The invention is particularly characterized in that the sums of impulses are fed to corresponding sections of storing elements and are transmitted for operating the inscribing device at the earliest during the feeling of the next image line. (Official Gazette)

29496 INSTALLATION FOR THE DETECTION OF INTERNAL CONVERSION PAIRS DURING THERMAL NEUTRON CAPTURE. Damyanov, D. B.; Kulyukin, M. M.; Khristov, V. I.; Shcherbakov, Yu. A. (Inst. of Nuclear Research and Nuclear Energy, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 11, 1441-1444(1973). (In Russian).

An installation for the detection of internal conversion pairs during thermal neutron capture by Ar is described. A diffusion chamber filled with the target gas is used in the installation as the pair detector. The performance of the installation is evaluated and a typical energy spectrum is shown. (JSR)

Radiation Dosimeters

Refer also to abstracts 29806, 30217, 30229, and 31051–31053.

29497 (AD-767263-7-GA) EFFECT OF LET ON THE CERIC/CUPRIC G-VALUE. Munno, F. J.; Smith, T. G. (Maryland Univ., College Park (USA). Dept. of Chemical Engineering). Jun 1973. Contract DAAA15-69-C-0755. 43p. NTIS $4.25.

The G(Ce(3+)) value of a 1 millimolar solution of ceric sulfate in a 100 millimolar solution of cupric sulfate in 0.4 molar H_2SO_4 was investigated. This quantity was measured for radiation of varying quality. The radiation sources included protons, alpha particles, and cobalt-60 gamma rays. The ceric/cupric solution was found to be sensitive to impurities, but in general could be managed. Results indicate that all glass systems are necessary for best results. (auth)

29498 (INDC(NDS)-56-U) PROCEEDINGS OF A CONSULTANTS' MEETING ON NUCLEAR DATA FOR REACTOR NEUTRON DOSIMETRY, VIENNA, SEPTEMBER 10–12, 1973. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). 1973. 145p. (CONF-730980-).

Separate abstracts were prepared for 8 of the 9 papers presented. One paper was previously abstracted in NSA as 28: 20289. (WHK)

For abstracts of individual papers see: 29435–29441, and 29499.

29499 (INDC(NDS)-56-U, pp 1-8) NEED FOR INTERNATIONALLY RECOMMENDED CROSS SECTIONS FOR NEUTRON DOSIMETRY REACTIONS. Farinelli, U. (CNEN, Rome). 1973.

From consultants' meeting on nuclear data for reactor neutron dosimetry; Vienna, Austria (10 Sep 1973).

The problems posed by the use of activation detectors for reactor dosimetry and in particular for the determination of neutron spectra are briefly discussed. The kind of problems for which activation detectors are needed are outlined; the procedure by which the required results is obtained from the activation data is considered; and it is attempted to deduce sensitivities of the final quantities to the cross section uncertainties and the type of information on the cross sections that is most needed is discussed. (WHK)

29500 (INIS-mf-780, pp 50-59) PHOTON COUNTING AS APPLIED TO THERMOLUMINESCENCE DOSIMETRY. Schlesinger, T. (Israel Atomic Energy Commission, Yavne); Avni, A.; Feige, Y.; Appelbaum, G.; Friedland, S. S. Nov 1972. (In Hebrew).

From proceedings of the 6th national conference of the Israel Health Physics Society; Nahal Soeq, Israel (19 Dec 1971).

The photon counting technique has been applied to thermoluminescence dosimetry. A comparison has been made between the sensitivity, accuracy, and signal-to-noise ratio obtained with a system based on this technique and a standard dc recording system. We can read at least down to 5 mR with a standard deviation of about 12% over 10 readings as compared to 25 mR with a standard deviation of 50% for the same number of readings. At 25 mR the signal-to-noise ratio for the new system is 1.3 as compared to 0.15 for the standard system. Refinements of our apparatus and techniques are expected to produce further improvements. (INIS)

29501 (INIS-mf-1110) EXPOSURE RATE DEPENDENCE OF THE THERMOLUMINESCENT RESPONSE. Zanetic, J. (Sao Paulo Univ. (Brazil). Instituto de Fisica). 1972. 79p. (In Portuguese). INIS.

Thesis.

Radiation-induced thermoluminescent emission of the crystals $Li_2B_4O_7$:Mn and CaF_2: natural (yellow specimen) was studied, with particular attention given to the low temperature glow peaks (~85°C in $Li_2B_4O_7$:Mn and ~120°C in CaF_2: natural). Since the response of the $Li_2B_4O_7$:Mn peak depends strongly on the exposure rate, the well known model for creation of traps is modified including an escape probability per time for the trapped electron. With this modification the model fits the observed TL response as a function of exposure rate. The 120°C glow peak in CaF_2 also depends on the exposure rate, but unlike $Li_2B_4O_7$ responds supralinearly in the region of interest. This behavior is also analyzed successfully with the modified model. Another observation is that as the CaF_2 peak fades at room temperature, its position shifts to higher temperatures. Accordingly, a model is applied that supposes a continuous distribution of trapping levels. With this model the energy E_0 and the frequency factor s are calculated giving good agreement with the decay of the glow peak as well as with the shift. Also a new experimental aspect of the TL emission of the CaF_2 glow peak is observed: shift of the peak's position to higher temperatures as the exposure rate increases. Measurements on two different $Li_2B_4O_7$:Mn samples indicate that an observed increase in peak separation results from increasing the Mn concentration. (INIS)

29502 (RD/B/N-2696) CRITICAL APPRAISAL OF THE PERFORMANCE OF THE FILM BADGE DOSIMETER IN SPECIALISED EXPERIMENTAL SITUATIONS. Charles, M. W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1973. 16p. Dep. NTIS (U. S. Sales Only) $4.00.

The use of the AERE/RPS personnel film badge for specialized experimental work is discussed and some laboratory experiments utilizing the film badge, in which anomalous effects were observed, are considered. The results are shown to support a more critical appraisal of the dosimetry techniques used in non-personnel measurements, such as in heat exchanger dose surveys. The use of thermoluminescence dosimetry as an alternative to the film badge in this type of application is suggested. (UK)

29503 (RL-74-2) DOSIMETRY BY CHARGE DECAY OF POLYMER THERMOELECTRETS. King, M. D. A. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Dec 1972. 20p. Dep. NTIS (U.S. Sales Only) $4.00.

An investigation into the possible use of electrets for personnel dosimetry is described. Fabel et al., in their paper Polymer Thermoelectrets (Phys. stat. sol.; (a)6:535(1971)) describe radiation dosimetry based on thermoelectrets of nylon, mylar, polystyrene and teflon. In the present investigation, electrets were made from mylar, teflon and megacel expanded polystyrene. Details are given of the preparation, irradiation and measurements. Preliminary results are reported. (UK)

29504 (STI/PUB-318(Vol. 1)) NEUTRON MONITORING FOR RADIATION PROTECTION PURPOSES. Volume I. Proceedings of a Symposium, Vienna, December 11–15, 1972. (International Atomic Energy Agency, Vienna (Austria)). 1973. 355p. (In Several Languages). (CONF-721203-P1). IAEA $16.00.

Separate abstracts were prepared for 24 of the 25 papers presented. One paper was previously abstracted in NSA as 27:2576. (WHK)

For abstracts of individual papers see: 29507–29513, 29530–29534, 30195, 30216, 30217, 30236, 30265, 31050–31053, 31078, 31079, and 31402.

29505 (ZFK-242) INTERPRETATION OF THE MEASURING VALUE OF MODERATOR SPHERE DOSIMETERS AS THE NEUTRON DOSE EQUIVALENT IN THE BODY SURFACE. Rossbander, W.; Adler, B. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Nov 1972. 9p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

Recent data on dose equivalents of broad neutron beams in a cylindrical phantom were compared with the former standard data in the NCRP-Report No. 20. The influence of the recent data on the Neutron Radiation Protection Guide is unessential for protection purposes. Comparisons between normalized dose rate equivalents (a) given for the body surface, (b) estimated for different volume elements in the cylindrical phantom for multilateral neutron incidence, and (c) estimated as measuring value of moderator sphere dosimeters have shown that in stray radiation fields the moderator sphere dosimeters cannot underestimate the dose equivalent in the body surface but can overestimate in the case of the 10" sphere dosimeter. A simple method is described to evaluate the overestimation of dose equivalents with moderator sphere dosimeters in stray radiation fields. (auth)

29506 IMPROVEMENTS IN OR RELATING TO READ-OUT APPARATUS FOR RADIATION DOSIMETERS. Brunskill, R. T.; Langmead, W. A. (to United Kingdom Atomic Energy Authority). British Patent 1,340,514. 12 Dec 1973. Filed date 6 Nov 1970. 3p.

Reference is made to read-out apparatus for thermoluminescence radiation dosimeters having thermoluminescent powder mounted on both faces of a base material, so that measurements of β- and

γ-radiation may be made concurrently (see BP 1340513). The read-out apparatus described comprises a pair of single coils of wire, located in spaced parallel planes, and connected to an rf supply, with two photomultiplier tubes located one on each side of the pair of coils, each photomultiplier having its longitudinal axis at right angles to the planes of the coils, with means provided for locating the dosimeter between the coils for read-out purposes. (UK)

29507 PASSIVE BROAD-ENERGY-RESPONSE NEUTRON SPECTROMETER-DOSIMETER. Piltingsrud, H. V. (Radiological Health Lab., Wright-Patterson AFB, OH); Engelke, M. J. pp 123-138 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The neutron spectrometer-dosimeter described is a completely passive device, intended for use in the measurement of the flux and energy spectra of neutrons in mixed radiation fields of charged particles, photons and neutrons. Its basic principle of operation is similar to that described by Engelke, wherein a stepwise response curve for the (n,α) reaction in ^6Li as a function of radius from the center of an 18-in.-diameter polyethylene sphere was measured. This curve was compared with theoretical response curves and the response curves obtained from exposures of the sphere to known energy and flux neutron fields in order to derive the spectra and flux of the measured neutron field. Previous applications of this principle required an omni-directional rotation of the sphere at a rate much higher than the rate of change of the radiation field being measured. The device utilizes an array of sensors throughout the sphere, making it a completely isotropic and passive sensor. Proton and photon field intensities and energies are also believed to be identifiable with this technique. (auth)

29508 NEUTRON MONITOR FOR RADIATION PROTECTION. Widell, C. O.; Svansson, L. (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 225-231 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The neutron monitor described is a portable instrument for use around neutron-producing equipment in a radiation protection program. The instrument measures the neutron dose rate in mrem/h with rem-dose response in the energy range from thermal to 17 MeV. The detector is a BF_3 proportional counter surrounded by polyethylene and boron plastic. The sensitivity is 3.6 counts/s per mrem/h of neutrons. The monitor is insensitive to gamma radiation up to 200 R/h. For pulsed radiation, the instrument can be used up to, for instance, 1 rem/h for 100 Hz without more than 30% counting loss. The detector can also be used separately from the electronics. In this case, the detector is furnished with an emitter follower. (auth)

29509 PORTABLE MIXED RADIATION DOSE-EQUIVALENT METER. Kuehner, A. V.; Chester, J. D.; Baum, J. W. (Brookhaven National Lab., Upton, NY). pp 233-246 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

A portable instrument has been developed which measures both absorbed dose and total dose-equivalent rates over six orders of magnitude. It is based on a 20-cm-diameter, modified Rossi-type tissue-equivalent linear energy transfer (L) spectrometer. The detector is sealed for up to six months, with the gas purity maintained by means of a desiccant. Detector microphonics are avoided by using a Benjamin-type electrode structure. Dose-equivalent values are obtained by means of a simple electrometer plus biased amplifier system. This system uses the detector as an ion chamber with gas gain, and at the same time as a proportional counter. The total current from the detector is proportional to the absorbed dose. Two biased amplifiers give additional gain to pulses from particles with L's greater than 3.5 keV/μm. These weighted pulses, when added to the current measurement, yield an output proportional to dose-equivalent. An internal alpha source permits several calibration checks to be made without external sources or equipment. When tested with monoenergetic neutrons and neutrons plus gammas, the instrument's errors have been less than ±12%. A recent application of the instrument has been to measure the natural background radiation profile at elevations up to 60,000 feet. For this measurement, it was adapted for automatic data recording by using two voltage-to-frequency converters and a register which prints the integral doses every two minutes. In this form, it is capable of monitoring dose rates over three decades without range switching. (auth)

29510 MEASUREMENT OF ABSORBED DOSES FROM INTERMEDIATE AND FAST NEUTRONS BY MEANS OF THE HURST PROPORTIONAL COUNTER METHOD. Sievers, H. F.; Zill, H. W. (Physikalisch-Technische Bundesanstalt, Brunswick). pp 247-255 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The pulse-height discriminator method used with the proportional counter dosimeter initially proposed by Hurst rejects not only small pulses due to secondary electrons from gamma rays, but also small pulses due to proton recoils. The error in dose measurement arising in this way can be reduced by discrimination between the different kinds of pulse by virtue of their different rise times and by selective rejection of pulses with long rise times produced by secondary electrons. This discrimination operates for PuBe neutrons down to energies of about 40 keV, and is carried out in a separate measurement with enlarged gas amplification in addition to the normal dose determination with pulse-height discrimination down to about 200 keV. For the measurement with rise time discrimination, the calibration of the dosimeter by injection of α-particles with total absorption of their energy cannot be applied, but must be replaced by a different procedure consisting in absorbing only part of the energy of the α-particles. Experiments with the pulse shape discrimination method and dose measurements in the radiation fields of an $^{241}Am(\alpha)Be$, a $Ra(\alpha)Be$, a $Pu(\alpha)Be$, and a ^{252}Cf fission source are reported. (auth)

29511 DOSIMETRY OF NEUTRON–GAMMA FIELDS. Alferovs, I. L.; Pasechnik, V. M.; Khrapachevskii, V. N. (Inst. of Nuclear Research, Kiev). pp 257-268 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The possibility of segregating individual current components in an ionization chamber with a small gas cavity and thereby determining experimentally the doses absorbed in a neutron-gamma field by different elements present in the materials of the ionization chamber is demonstrated. Using a plane ionization chamber with a variable electrode gap, they measure the proton components of the current and the relative proton stopping powers of hydrogenous materials. They determine the proton component of the dose absorbed by emitters in the neutron-gamma field of a reactor beyond paraffin scatters of different thicknesses. The authors hope to determine the other components of the ionization current in such a chamber; it would then be possible to measure the absorbed doses attributable to neutrons, not only in hydrogen but also in other simple substances, and the gamma component of the dose in mixed fields without recourse to neutron spectrometry source measurements. (auth)

29512 INFLUENCE OF DETECTOR TYPE AND EQUIPMENT ON THE SENSITIVITY OF BONNER SPHERES. Rohloff, F.; Heinzelmann, M. (Kernforschungsanlage, Juelich, Ger.). pp 269-277 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

Bonner spheres are widely used in neutron dosimetry. Although detectors of different types are used, the influence of the detector on the moderating and counting mechanism has been to a large extent neglected, on the assumption that these influences are smoothed out by calibration. Only a few calculations and fewer measurements have hitherto been available which took into account the full influence of the detector. The authors have performed calculations on two detecting devices: a polyethylene sphere with a LiI-detector and one with a ^3He detector. The calculations were done with the discrete-ordinate-method, and the results show, for a moderating sphere of 10-in. diameter, a sharper variation of sensitivity for energy in the interval between 0.1 MeV and 1 MeV against earlier calculations, and, for a moderating sphere of 3-in. diameter, a less pronounced energy dependence. There is also a marked influence of the light-pipe on detector-sensitivity. This influence is dependent on the energy of the incident neutron radiations. The sensitivity of a sphere of 2-in. diameter and a rather large-pipe subject to radiation of an Am-Be source is less by 40% than that of a homogeneous polyethylene sphere; these measurements were done with activation foils. (auth)

29513 RESPONSE OF DETECTORS IN SPHERICAL MODERATORS TO MONOENERGETIC NEUTRONS. Bricka, M.; Dolias, M.; Lamberieux, J.; Caizergues, J. (CEA, Cadarache, France). pp 279-295 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The response of Bonner spheres to monoenergetic neutrons in different energy ranges has been obtained by theoretical or experimental methods and in some cases by both. The multigroup transport theory (ANISN and DTF IV codes) can be used to calculate responses in the energy range from thermal to 10 MeV with the help of the conjugate flux. At thermal energies they are also calculated by the elementary diffusion theory. The responses of spheres with a ^{6}Li detector in the center are determined experimentally in the subcadmium and epicadmium regions from 5 keV to 3 MeV using the Van de Graaff generator at the Cadarache Nuclear Research Centre. Their response to different sources is calculated on the basis of the data thus obtained and compared to that for activation detectors. Lastly, spheres having a different type of central detector (BF_3 and ^{3}He counters and manganese detector) are also discussed. A part of these studies was carried out under contract with EURATOM. (auth)

29514 IONIZATION METHOD OF NEUTRON DOSIMETRY IN RADIOBIOLOGICAL EXPERIMENTS. Bregadze, Yu. I.; Maslyaev, P. F. pp 8-14 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

The ionization method of separating measurements of the absorbed dose of gamma and neutron radiation in mixed gamma and neutron radiation fields was studied. Model equipment was developed and fabricated. The recorder is a weak-current integrator that measures currents as small as 10^{-13} amp. The ionization chamber is made from polyethylene, polystyrene, or graphite and is filled with ethylene, acetylene, or CO_2, respectively. With this equipment, doses from 10^{-3} to several rads/sec can be measured. The results of measurements in the three chambers were processed by the least-squares method. (tr-auth)

29515 SOME USES OF THERMOLUMINESCENT DOSIMETRY AT ACCELERATORS. Engelke, M. J. (Los Alamos Scientific Lab., NM). pp 895-909 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

Some applications of thermoluminescent dosimetry to health physics problems encountered at accelerators are described. A convenient method of measuring integrated exposures in a mixed radiation field is discussed where miniature LiF dosimeters are placed in various diameter polyethylene spheres. Preliminary investigations using these spheres as a neutron spectrometer have been initiated. A rapid and simple assessment of personnel radiation exposure to gammas is described where miniature thermoluminescent dosimeters are incorporated into the frames of eyeglasses. The evaluation of the integrity of a shield wall is made by insertion of a 12-ft wand through the shield with TLD's spaced every four inches. The practical use and limitations are discussed. (auth)

29516 PERSONAL MONITORING AT A FOUR MEV VAN DE GRAAFF ACCELERATOR WITH TISSUE-EQUIVALENT POCKET DOSIMETERS. Sreniawski, D. J.; Frigerio, N. A. (Argonne National Lab., IL). pp 939-949 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

The operators and users of a 4-MeV de Graaff accelerator historically had been assigned film badges using Kodak NTA film as personal monitors for neutron radiation. When a review of their cumulative neutron exposures as reported by film badges was not supported by radiation survey records of the work areas, a study was made to determine the reason. The study found that the neutron average energy was less than 200 keV in areas occupied by the accelerator personnel. Neutrons of this energy are below the region of effective interpretation for the Argonne National Laboratory film badge. A search was initiated for a supplement to the film badge resulting in the adoption of a tissue-equivalent ionization chamber pocket dosimeter. Tests made to determine its energy dependence are described. (auth)

29517 LYOLUMINESCENT TISSUE EQUIVALENT RADIATION DOSIMETER. Atari, N. A.; Ettinger, K. V. (Univ. of Birmingham, Eng.). Nature (London); 247: No. 5438, 193-194(25 Jan 1974).

When some irradiated solids are dissolved in water or certain other solvents light emission occurs, which is termed "lyoluminescence". In the case of inorganic materials, such as alkali halides, reactions of trapped electrons from F-centers are responsible for the light emission, and with organic materials, such as saccharides, trapped free radicals are involved. Application of "lyoluminescence" to dosimetry is described. It is possible to measure doses of between 1 and 10^7R in this way with an accuracy of 5% using NaCl with water as solvent. The stored lyoluminescent energy in NaCl decreases by only 15% after seven months of storage, but is sensitive to optical and thermal bleaching. Furthermore, the effective atomic numbers of NaCl is approximately 16, differing considerably from that of human tissue (above 7.5). Study of monosaccarides, including glucose, xylose and mannose, has demonstrated the stability of the trapped free radicals, and no decrease in their lyoluminescence was observed over 7 months. As regards their use for dosimetry they show linear dependence with dose up to 100 kR, and the lowest dose indicated under test was 100 R. It is considered possible to use the lyoluminescence of saccharides for clinical dosimetry if the sensitivity of the systems could be improved, and to this end tests were carried out using luminol solution. Using a ^{60}Co γ-source irradiated saccharides give bright blue light when dissolved in luminol solution, and the light enhancement was about 10^6 compared with water. It seems likely that the oxidizing species responsible for exciting the luminol are formed as a result of free radical reactions with dissolved or adsorbed O_2 in the system. Trehalose, which is a fairly true tissue equivalent material, appears to be a good candidate for lyoluminescence dosimetry. (UK)

29518 DEVELOPMENT OF A NEW LUMINESCENT MATERIAL FOR THERMOLUMINESCENCE DOSIMETER. Kotera, N.; Toryu, T. (Dai Nippon Toryo Co. Ltd., Osaka). Funtai Oyobi Funmatsuyakin; 19: No. 7, 271-280(Feb 1973). (In Japanese).

The performance and properties of Mg_2SiO_4 – Tb and MgB_4O_7 – Tb for use as thermoluminescent dosemeters are reported. (TFD)

29519 ENERGY AND ANGLE DEPENDENCE OF CALCIUM FLUORIDE AND LITHIUM FLUORIDE THERMOLUMINESCENT DOSIMETRY SYSTEMS. Gibbs, S. J.; Mitchell, A. C. (Vanderbilt Univ., Nashville). Oral Surg., Oral Med., Oral Pathol.; 37: No. 4, 641-648(Apr 1974).

Effects of x-ray exposure geometry on CaF_2 and LiF thermoluminescent dosimeters have been characterized at a variety of x-ray beam energies. Results indicate limited usefulness of CaF_2 chips for determination of patient dose from dental radiographic procedures. The response of CaF_2 chips is dependent upon the angle of incidence of the dental x-ray beam and upon its energy. (auth)

29520 METHOD AND APPARATUS FOR TREATING THERMOLUMINESCENT DOSIMETERS DURING READOUT TO ENABLE THEIR IMMEDIATE REUSE. Webb, G. A. M.; Phykitt, H. P. (to Isotopes, Inc.). US Patent 3,790,784. 5 Feb 1974. Filed date 6 Jun 1972. 12p.

A method and apparatus for treating thermoluminescent dosimeters to enable read-out of the dosimeters and to permit their prompt reuse by eliminating the conventional annealing cycle is described. The dosimeter is initially preheated to a first temperature and is maintained at that temperature for a predetermined time. The dosimeter is then heated to a second read-out temperature and is maintained at the read-out temperature for a selected time interval. The dosimeter is then immediately heated further to an annealing temperature which is maintained for a selected interval, followed by cooling of the dosimeter whereby the dosimeter can again be promptly reused for accurately determining radiation dosage without the necessity of subjecting the dosimeter to the conventional and lengthy annealing cycle. (Official Gazette)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 28971, 29292, 30266, and 31275.

29521 (AD-770370) EVALUATION OF OPERATIONAL CHARACTERISTICS OF SELECTED UNFOLDING CODES. Kilminster, D. T. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Sep 1973. Contract DA-1-B-062118-AD-51. 67p. (BRL-1675). NTIS $5.50.

A study was conducted to determine the sensitivity of three computer codes (SAND 2, SPECTRA, and FERDOR) used for unfolding neutron spectra from activation foil data to errors in measured foil activities and to the choice of first-approximation spectra, and to evaluate these codes in terms of computer run time, user intervention, and required user experience. As a result of the study, it was concluded that the solution spectrum is much more sensitive to the choice of the first-approximation spectrum than to errors in the measured foil activities; the solution spectrum is more accurate in energy intervals containing many neutrons than in intervals containing few neutrons; FERDOR,

in the form received, was unsuitable for unfolding neutron spectra from activation foil data; comparison of the computing run times of the two remaining codes is unwise because of the number of variables involved; and unfolding codes require considerable user experience in order to produce meaningful solution spectra. (auth)

29522 (BNWL-SA-4876) COMPARISON OF Ge(Li) AND ANTI-COMPTON SYSTEMS FOR MEASUREMENTS OF ENVIRONMENTAL SAMPLES. Wogman, N. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. 25p. (CONF-731112-33). Dep. NTIS $3.25.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

There are numerous reasons for performing environmental measurements for routine health or safety monitoring and to determine the movement of trace elements or radionuclides through our environment to man. This is often a requirement for the licensing of nuclear power reactors, as well as many other meteorological or environmental research experiments. In this paper a variety of sensitive low-level counting systems are discussed from an analyst's viewpoint, centering on a variety of NaI(Tl) and Ge(Li) gamma ray spectrometers. The coincident gamma-ray emitters are most sensitively detected through NaI(Tl) multidimensional gamma ray spectrometry, while single gamma ray emitters are very sensitively detected with Ge(Li) detector systems. NaI(Tl) detector systems are superior in general for environmental measurements. (auth)

29523 (LA-tr-74-5) DETERMINATION OF EFFICIENCY AND DIRECTIONAL RESPONSE OF COSMIC GAMMA-RADIATION DETECTORS. Golenetskii, S. V.; Il'inskii, V. N.; Mazets, E. P. (AN SSSR, Moscow. Fiziko-Tekhnicheskij Inst.). Feb 1974. Translation by H. J. Dahlby of FTI-455. 22p. Dep. NTIS $4.25.

The calibration technique for the scintillation detector of the gamma spectrometer of the Kosmos 461 satellite is considered. The total gamma-radiation detection efficiency, photoefficiencies, and photofractions for a detector in both a parallel and isotropic flux were determined within a broad energy range. The technique described can be used also in calibration of more complicated detector arrangements, including active and passive collimators and shields. The directional response features of the detector are discussed. The possibility is shown of constructing a detector system to determine the direction of the radiation source to a few degrees. Such a system can be used to study cosmic gamma-radiation bursts. (auth)

29524 (LNF-73-57) REALIZATION AND SETTING UP OF A NEUTRON SPECTROMETER IN THE RANGE FROM 0.2 TO 12 MeV. Merolli, S.; Roccella, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 28 Sep 1973. 7p. Dep. NTIS (U. S. Sales Only) $4.00.

A neutron spectrometer has been realized using γ-n discrimination on the pulse shape in a trans-stilbene crystal. Discrimination efficiency has proved to be higher than $1^0/_{00}$ up to proton energies of about 150 to 200 keV. The efficiency of proton detection was practically equal to 1 for protons of energy $\geq$ 0.6 MeV. In order to extend the energy range of utilization of the spectrometer to lower values, proton detection efficiency has been measured up to 150 keV discriminating γ from neutrons in an Am–Be source by means of time-of-flight. An efficiency of about 30% has been measured at such energies. The spectrometer has been realized especially in view of its exploitation at γ high dose rate and arrangements have been adopted for this purpose that allow to improve discrimination power by a factor higher than 10. (auth)

29525 STUDY OF THE USE OF PARTICLE CHANNELING IN TIME-OF-FLIGHT FISSION-FRAGMENT MASS-YIELD MEASUREMENTS. Sullivan, W. J.; Wehring, B. W. (Univ. of Illinois, Urbana). Nucl. Instrum. Methods; 116: No. 1, 29-39(1974).

A direct physical measurement of the mass distribution in the thermal-neutron fission of ^{235}U was made using the single time-of-flight method and particle channeling in the energy detector. Particle channeling was employed in an attempt to achieve good energy resolution to give a mass resolution of better than 1 amu. A totally depleted silicon surface-barrier detector having the [110] crystal axis approximately perpendicular to its face was used as the energy detector with the fragments entering the Al (20 $\mu g/cm^2$) window. Channeling of fragments was achieved with about 80% of the light fragments and 55% of the heavy fragments remaining in the channels. From the results of the experiment a new picture for dechanneling was postulated. Previous results indicated that some of the heavy ions entering a detector within the critical acceptance angle for channeling were dechanneled in the metallic window. Our results indicated that the fragments dechanneled in the silicon detector somewhere in the middle of the fragment path. The results of the experiment also suggest that channeling of fragments eliminates the nuclear stopping defect and most of the recombination defect. The mass distribution calculated from the data for the channeled fragments, however, did not show that 1-amu mass resolution had been achieved. Subsequent experiments at the Oak Ridge National Laboratory Tandem Van de Graaff accelerator with the same detector showed that the energy resolution achieved with Al entrance window was not good enough for 1-amu mass resolution. (auth)

29526 DIGITAL CONTROLLED POWER SUPPLY WITH AUTOMATIC DEMAGNETIZATION PROGRAM FOR MAGNETIC SPECTROMETERS. Fellmann, S.; Patt, B.; Thielmann, R.; Kobrzynski, T. (Univ., Marburg, Ger.). Nucl. Instrum. Methods; 116: No. 1, 77-84(1974). (In German).

A versatile equipment for current supply and automatic operation of magnetic beta spectrometers has been developed. The arrangement consists of a transistorized current source with a digital control unit allowing the adjustment of the spectrometer current in steps from 400 μA to 40 A within preselectable lower and upper limits. Maximum current available is 400 A with a stability of 10^{-6}. An automatic demagnetization routine is provided for use with non iron-free spectrometers. Characteristic examples for measurements in the various operation modes of the automatic device are presented. (auth)

29527 ANALYSIS OF GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN A TRIPLE CASCADE. Chow, G. Y. (Saginaw Valley Coll., University Center, MD; Gardulski, P. L.; Wiedenbeck, M. L. Nucl. Instrum. Methods; 116: No. 1, 105-107(1974).

If a triple cascade exists among the nuclear levels of an isotope, the (1–3) directional correlation coefficients combined with those of the (1–2) and (2–3) cascades offer an effective way for determining mixing ratios or spin sequences. A formula is given to determine the mixing ratios for the intermediate transition directly, regardless of whether or not the other two transitions are mixed. Graphs are introduced for analyzing triple cascades. (auth)

29528 DIRECTIONAL DEPENDENCE OF ENERGY MEASUREMENTS IN Ge(Li) SPECTROMETERS. Lichtenberger, P. C.; MacKenzie, I. K. (Univ. of Guelph, Ont.). Nucl. Instrum. Methods; 116: No. 1, 177-179(1974).

Precise measurements of the energy of gamma rays show variations up to 110 eV, depending on the direction from which the radiation is incident on a trapezoidal Ge(Li) detector. (auth)

29529 IMPROVEMENTS IN PROTON SPECTROSCOPY WITH Si(Li)-DETECTORS BY RISE TIME DISCRIMINATION. Lindstroem, G.; Lisdat, R. (Univ., Hamburg). Nucl. Instrum. Methods; 116: No. 1, 181-184(1974).

Considerable improvements in the peak-to-background ratio for the detection of 20 MeV monoenergetic protons were achieved with pulse-shape discrimination techniques by selecting a certain rise time range. A discussion of the results is given. (auth)

29530 MEASUREMENT OF SPECTRAL DISTRIBUTIONS OF NEUTRONS FROM RADIOACTIVE SOURCES AND URANIUM-235 FISSION, AND THE RESULTING FLUENCE-DOSE CONVERSION FACTORS. Kluge, H.; Weise, K.; Zill, H. W. (Physikalisch-Technische Bundesanstalt, Brunswick). pp 13-22 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The spectral distributions of neutrons from three sources (Ra-α-Be, ^{241}Am-α-Be, and ^{239}Pu-α-Be) and from the thermal fission of ^{235}U were investigated in the energy range from 90 keV to 11 MeV. Below 1.3 MeV, the measurements were carried out by means of a recoil proton telescope with a gaseous radiator consisting of two proportional counters connected by a collimator. Here, the energy of the protons released by the neutrons is determined by analyzing the sum of the coincident pulses from both counters if there is no signal from a third counter behind the second one. For energies above 1.2 MeV, another recoil proton telescope with a thin tristearin radiator layer was used. After the recoil protons have passed two proportional counters for angular definition, their energy is measured by a semi-conductor detector. By applying the theoretical proton energy distribution for monoenergetic neutrons, the measured distribution was unfolded to get the neutron spectrum. From the spectral distributions of neutrons, the mean conversion factors for fluence to absorbed dose and fluence-to-dose-equivalent as functions of the penetration distance, the mean fluence-kerma and the mean fluence-maximum dose equivalent conversion factors were calculated, together with the respective effective energies and the mean and effective quality factors. (auth)

29531 DATA ANALYSIS FOR LOW-RESOLUTION NEUTRON SPECTROMETRY. Gruenauer, F.; Schmatz, W. (Gesellschaft

fuer Strahlen- und Umweltforschung mbH, Munich). pp 59-71 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

In neutron radiation protection, especially in connection with field monitoring, it is often desirable to know the neutron spectrum. Practical measuring devices whose response covers the total energy range of interest, such as the Bonner multi-sphere spectrometer, have poor energy resolution. In these cases, the spectra have to be unfolded from the count-rate vectors. In general, it is necessary to use "a priori" information for this kind of analysis. Test calculations have been performed with several unfolding techniques which are analyzed with respect to the following criteria: (a) how reasonable the implicit assumptions are for the results; (b) the extent to which "a priori" information be used; (c) whether measuring errors are considered and to what extent; and (d) what the "true" energy resolution of the method is. The common principles of the different techniques are discussed, leading to a systematic survey. An unfolding procedure based on the so-called "window concept" is demonstrated. Here the solution is obtained in terms of confidence intervals for the scalar product between the unknown spectrum and "window functions". All errors of measurement, calibration, and the uncertainties in the response functions are considered. The influence of all these errors is shown. (auth)

29532 EXPERIMENTAL DETERMINATION OF RESPONSE FUNCTIONS OF AN ORGANIC LIQUID SCINTILLATOR IN THE ENERGY RANGE FROM 0.6 TO 12.4 MeV. Schaenzler, L.; Stueker, S. (Forschungsinstitut, Muenster, Ger.). pp 87-95 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

Fast-neutron spectroscopy with thick organic scintillators is possible if the response matrix of the scintillator is known and a computer program is available for unfolding the proton recoil spectra. Since the response matrices of two scintillation detectors with multipliers of the same type and scintillators of the same material and size are not identical, it is not advisable to use a response matrix published in the literature without testing its suitability for one's own detector. The authors therefore measured 38 response functions in the neutron energy range between 0.6 and 12.45 MeV, using a method which had so far not been applied for this purpose. Since no variable energy accelerator was available but only a 500-keV, 2-mA cascade generator, capable of producing 14-MeV neutrons at a rate of 2×10^{11} n/s, the authors were forced to generate neutrons in the range 0.6 to 14 MeV by scattering and to determine their energies by the time-of-flight technique. Behind a collimator, the 14-MeV neutrons were scattered in a plastic scintillator (7 cm × 7 cm diam.) which provided the start signals; subsequently they were detected in the NE 213 detector at a distance of 1 m and at various angles to the direction of the primary neutrons. The pulse-height signals of the Ne 213 detector and the time-of-flight signals were obtained in a two-dimensional analyzer. Elastically and inelastically scattered neutrons were contained in the two-dimensional spectra with different intensities. Choosing different measuring periods and summing up the spectra of the various angles, the authors achieved nearly equal statistics for all neutron energies. They obtained time resolutions of 1.6 ns for 12.4 MeV, which correspond to an energy resolution of about 13%. After normalizing and binning their measured response functions, they observed adequate correspondence between their results and the functions determined by Verbinski et al., which are contained in the FERDOR unfolding code developed by Burrus. It must be emphasized, however, that the authors selected a scintillator-multiplier-combination for their measurements, which showed ample conformity between the pulse-height spectrum at 15-MeV neutron energy and the corresponding FERDOR function. (auth)

29533 MULTISPHERE NEUTRON SPECTROMETRY TECHNIQUE BASED ON HYBRID MODERATORS. Andreeva, L. S.; Keirim-Markus, I. B.; Savinskii, A. K.; Uspenskii, L. N.; Filyushkin, I. V. (Inst. of Biophysics, Ministry of Public Health, Moscow). pp 97-111 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

A variant of the multisphere neutron spectrometry technique developed by the author is described. As neutron detector a scintillator based on the luminous compound T-1 (ZnS(Ag) with boron) dispersed in "orgsteklo" ("organic glass") was used. In spectrum measurements the detector, connected to a photoelectric multiplier by means of a light pipe, is placed at the geometric center of four spherical moderators in succession. Two of the moderators are hybrid—i.e., over a certain distance they contain a cadmium interlamination. The author quotes the sensitivities of 11 detectors to 0.4 eV to 10 MeV neutrons and to thermal neutrons and describes a method of obtaining spectra on the basis of the measurement results. Lastly, information is given on the reproducibility of the results obtained with this technique. (auth)

29534 NEUTRON SPECTROMETRY FROM 1 MeV TO 1 GeV. Madey, R.; Waterman, F. M. (Kent State Univ., OH). pp 113-121 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

There is a need for an instrument to measure the fluxes and spectra of neutrons from 1 MeV to about 1 GeV. The authors have developed a self-contained time-of-flight spectrometer for neutrons and have measured neutron spectra in the region from 1 to 500 MeV. The spectrometer consists basically of two scintillation counters. The principle of the spectrometer requires an incident neutron to scatter elastically from a proton in the first scintillator, travel over a known flight path, and interact in the second scintillator. The time interval between these scintillation pulses is the time-of-flight of the scattered neutron. Kinematically, the kinetic energy of the incident neutron is specified in terms of the scattering angle, the flight path, and the flight-time of the scattered neutron. A typical spectrometer configuration for neutrons above about 15 MeV consists of a 2½ in. diam. by 2½ in. high first detector and a 9 in. diam. by 8 in. thick second detector spaced 4 m from the first detector and at an angle of 40° with respect to the direction of the incident neutrons. For this configuration, the energy resolution varies from 7% to 20% and the spectrometer efficiency varies from 2×10^{-8} to 8×10^{-7} over the range of energies from 10 to 500 MeV. In measurements made thus far, the count rate of real events was typically 1 count/s. A modified version of the spectrometer has been designed to extend the range of the spectrometer upward to about 1 GeV. In the modified version, a telescope of two scintillation counters detects the recoil proton in coincidence with the scattered neutron. The quadruple coincidence requirement reduces the background from chance coincidences and from competing inelastic reactions of neutrons with carbon and hydrogen in the first scintillator; however, since the recoil proton must escape the first detector, this technique becomes increasingly inefficient below about 200 MeV. (auth)

29535 NEW 14 MeV NEUTRON TIME-OF-FLIGHT SPECTROMETER AT THE KYUSHU UNIVERSITY. Matoba, M.; Hayakutake, M.; Tonai, T.; Niidome, J.; Matsumoto, Y.; Kimura, N. (Kyushu Univ., Fukuoka). Nucl. Instrum. Methods; 116: No. 2, 405-412(1974).

A 14-MeV neutron time-of-flight spectrometer having a 7.6 m flight path is described. An energy resolution of 260 keV for the 14-MeV neutrons has been obtained at a neutron intensity of 2×10^5 n/s. The reduction of the background was achieved as a result of a set-up of the neutron detector out of the measuring room, a study of the neutron collimator, and the use of an excellent discrimination circuit for neutrons and γ-rays. (auth)

29536 APPLICATION OF A STATISTICAL DESCRIPTION FOR COMPLEX SPECTRA TO THE (n,γ) REACTION. Colenbrander, A. H.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Nucl. Instrum. Methods; 116: No. 2, 251-265(1974).

A technique for localization of the response function of a Ge(Li) pair spectrometer is presented. Its application to gamma-ray spectra following neutron capture for several nuclides has permitted the evaluation of a new method of spectral analysis. This method, based upon a statistical description of spectra, allows the extraction of estimates for the number of transitions per energy interval and the average intensity per transition. Through the development of a simple cascade model of the (n,γ) reaction it is shown that the spectral density can be related to the nuclear level density at the neutron binding energy and the nuclear temperature. Results are obtained with this approach and are found to be in good agreement with data obtained by traditional non-statistical means. (auth)

29537 RESPONSE FUNCTION OF A 1-INCH DIAMETER BY 6-INCH LONG ^{3}He PROPORTIONAL COUNTER TO NEUTRONS. Nishino, S.; Nakamura, T.; Hyodo, T. (Kyoto Univ.). Mem. Fac. Eng., Kyoto Univ., 35: No. 3, 309-329(Jul 1973).

The response of a 1-in dia by 6-in. long ^{3}He proportional counter, of which the gas filling is 4 atm ^{3}He and 2 atm krypton, to axially incident neutrons was studied and expressed as a 50 by 50 matrix for an energy range from zero to 5 MeV. Applications of

the matrix were examined for the purpose of obtaining response-corrected spectra of neutrons transmitted through a matter. (auth)

29538 REALIZATION OF A STATISTICAL DESCRIPTION FOR COMPLEX SPECTRA. Colenbrander, A. H.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Nucl. Instrum. Methods; 116: No. 2, 237-249(1974).

A heuristic treatment is used to explore the possibility of employing a statistical description for complex spectra. The properties of gamma-ray spectra are examined and it is found that several models applicable to such complex data can be derived. One of these models permits the extraction of component density and average intensity for spectra exhibiting any degree of complexity. The effect of finite system response and truncation of records on the estimates for average density and intensity are examined, and the necessary corrections are derived. A localized spectrometer response is assumed. Although examples are taken from the field of gamma-ray spectroscopy, the treatment is valid for a large class of spectral data. (auth)

29539 SPECIAL GLASSES AS ENERGY DETECTORS FOR FISSION FRAGMENTS. Aschenbach, J.; Fiedler, G.; Schreck-Koellner, H.; Siegert, G. (Univ., Giessen, Ger.). Nucl. Instrum. Methods; 116: No. 2, 389-395(1974).

The suitability of various glasses for determination of the energy of fission fragments was investigated. For this purpose, the diameter or the area of the fission fragment tracks of particles of well-known mass and kinetic energy were correlated with the energy and the particle velocity, respectively. The fission fragment track was made visible through etching, and for long etching times, a linear dependence between the surface area of the pits and the particle velocity was observed. A similar relationship has been found between the area of the etch pits and the etching time. Glasses with a high phosphate content have by far the most desirable properties and from these glasses high resolution detectors were constructed. Results indicate that a resolution of about 1 to 2 MeV is possible. Furthermore, investigations show that, while borate glasses are also usable, the energy resolution is poorer, but silicate and fluoride glasses in general have little energy resolution. As an application of the detectors, various energy spectra from fission fragments are presented. (auth)

29540 SCINTILLATION METER-TYPE SPECTROMETER. Menefee, J. M.; Novak, W. P.; White, J. A. (to Bicron Corp.). US Patent 3,798,448. 19 Mar 1974. Filed date 11 May 1972. 6p.

An improved scintillation meter component for a radiation detector having a photomultiplier tube optically coupled to a solid scintillation crystal is described. The crystal is coated with an optical decoupling agent to balance the light output sensed by the photocathode. (Official Gazette)

29541 NEW PRISMATIC β SPECTROMETER WITH HIGH RESOLUTION. Akhmetov, K. M.; Basin, L. A.; Bobykin, B. V.; Kel'man, V. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 1, 29-33(Jan 1974). (In Russian).

The construction and characteristics of a β spectrometer using a double magnetic prism with a high degree of two-dimensionality in the field is described in some detail. (JSR)

High Energy Physics Instrumentation

Refer also to abstracts 30250, 30254, 30255, 30257, 30259–30261, 30263, 30284, and 30490.

29542 (CERN-74-6) VERSATILE CABLE AND CONNECTOR ASSEMBLY TESTING APPARATUS (NP 2026). Harrison, K. (European Organization for Nuclear Research, Geneva (Switzerland)). 4 Mar 1974. 15p. Dep. NTIS (U. S. Sales Only) $4.00.

Detailed circuit descriptions, drawings, and photographs are given of a solid-state apparatus developed to test cable or wiring assemblies especially wire spark chambers, with a maximum capacity of 244 individual conductors. Intermittent or permanent faults of either open- or short-circuit conditions are displayed. The apparatus, housed in a standard CERN chassis, accepts standard adapter plug-in units, which are easily constructed for use with almost any type of connector. (auth)

29543 (LNF-73-56) 180° MAGNETIC SPECTROMETER WITH HELIUM FILLED STREAMER CHAMBER. Balestra, F.; Barbini, R.; Busso, L.; Falomkin, I. V.; Garfagnini, R.; Guaraldo, C.; Kulyukin, M. M.; Piragino, G.; Scrimaglio, R.; Shcherbakov, Yu. A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 27 Sep 1973. 16p. Dep. NTIS (U. S. Sales Only) $4.00.

The experimental apparatus exposed to the LNF–LEALE pion beam to measure the large angle pion-nucleus scattering is described. This 180° spectrometer consists of a streamer chamber filled with helium at atmospheric pressure, placed in a magnetic field, and used for identification of scattering events. The required degree of localization and brightness of the tracks is obtained without using a Blumlein transmission line. Finally, the momentum resolution obtainable with this spectrometer has been evaluated by a Monte Carlo technique. (auth)

29544 (RL-73-153) REPORT ON THE N.E.F. GROUP COATING PLANT. Seager, P. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Dec 1973. 36p. Dep. NTIS (U. S. Sales Only) $5.00.

A description is given of a plant designed for the vacuum deposition of two layer antireflection coatings onto the optics of the 1.5 metre cryogenic bubble chamber. Details of the plant are given; and procedures used in coating, details of coatings, and operating instructions for the coating plant are described. (UK)

29545 (RL-74-35) STUDY OF THE VARIATION OF THE NEON CONCENTRATION DURING AN EXPERIMENT WITH A TRACK SENSITIVE TARGET. Guy, J. G. V.; Wignall, J. W. G.; Fisher, C. M. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1974. 14p. Dep. NTIS (U. S. Sales Only) $4.00.

Muons from 1600 π^+ decays have been measured in hydrogen and the hydrogen-neon mixture that surrounds the track sensitive target during a 500,000 picture physics run at the 1.5 m cryogenic bubble chamber. It is found that both the variation of neon concentration and its absolute value are well determined by using the 2 mm long muons. (auth)

29546 (UH-511-161-73) BUBBLE CHAMBER SCANNING AND LIBRARY SYSTEM FOR THE UNIVERSITY OF HAWAII HIGH ENERGY PHYSICS GROUP. Jerome, J.; Roseman, W.; Wohlmut, P. (Hawaii Univ., Honolulu (USA). Dept. of Physics). 12 Dec 1968. Contract AT(04-3)-511. 78p. Dep. NTIS $6.00.

A general bubble chamber scanning system has been developed at the University of Hawaii, utilizing topological frame information which has proved to be extremely rapid and efficient, and is experiment independent. Frame information is recorded orally and translated to punched cards from audio tapes by keypunch operators. The Fortran program BRANDX is a library system created for the scanning procedure. It maintains a complete record of all scanning information and updates this with a summary of measuring information. In general, it is a usable system for any records utilizing sequential indicative information. (auth)

29547 FAST AND POWERFUL SYSTEM TO MEASURE DIFFICULT BUBBLE CHAMBER EVENTS. Berschin, J.; Johnson, K.; Krause, P. J.; Stroebele, H. (Univ., Heidelberg). Nucl. Instrum. Methods; 116: No. 1, 17-19(1974).

A television system has been incorporated into the Heidelberg PEPR-hardware, which enables an operator to digitize points on bubble chamber film with a precision of better than 10 μm. A mirror flipped into the optical path projects the film illuminated by the bright face plate of the cathode ray tube onto a television camera. The vidicon together with a reference mark created by the electron beam on the CRT-face plate may be moved to any point on the film by means of a speed ball. A PDP-10 computer controls the PEPR-device. In addition, it does automatic tracking following starting at clear points and calculates circle and vertex fits. Complicated track images may be digitized completely manually. Output consists of fiducials, up to 16 points per track, vertices and stop points. With this system, events which failed the first measurement done with a minimum guidance system are processed. About 20 events in three views can be measured per hour with a success rate of about 75% after kinematical analysis. This results in an overall success rate of 95% after the second measurement. (auth)

29548 ALIGNMENT OF WIRE SPARK CHAMBERS IN A COSMIC-RAY MAGNETIC SPECTROMETER BY MUONS TRAVERSING THE ZERO-FIELD REGION. Bella, G.; Yeivin, Y. (Tel Aviv Univ., Israel). Nucl. Instrum. Methods; 116: No. 1, 141-144(1974).

A method is proposed to align wire spark chambers, which are used as particle detectors in a cosmic-ray muon magnetic spectrometer, by analyzing the trajectories of the muons which traverse the spectrometer through the zero-field region. The displacements and rotations of the chambers relative to each other can be determined by least-squares fitting of the trajectories of these muons to straight lines. The accuracy obtained for an arbitrary configuration of 22 chambers and 500 (simulated) trajectories is better than 0.25 mm. (auth)

29549 PARTICLE SHOWER DETECTOR: THE MULTIPLATE STREAMER CHAMBER. Dayon, M. I. (Inst. for Theoretical

and Experimental Physics, Moscow); Egorov, O. K.; Euschenko, V. A.; Krilov, S. A.; Makarov, L. G.; Sheynkman, V. A.; Smirnitskii, V. A.; Weissenberg, A. O. Nucl. Instrum. Methods; 116: No. 2, 329-331(1974).

The electron shower detection properties of the multiplate streamer chamber were studied. In a magnetic field such a chamber with several plates of heavy matter with a total of 2 to 3 radiation lengths provides reliable and near 100% identification of electrons with energies about 200 MeV. (auth)

29550 RESPONSE OF A LARGE ALL-LIQUID SCINTILLATION SPECTROMETER AND OF A 24-LAYER IRON-PLASTIC SPECTROMETER TO CHARGED PIONS AND PROTONS IN THE LOW-GeV ENERGY RANGE. Gabriel, T. A.; Amburgey, J. D. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 116: No. 2, 333-344(1974).

To aid in the design of a particular class of ionization spectrometers, calculations have been carried out to determine the response of a large all-liquid scintillation spectrometer to incident protons and charged pions in the low-GeV energy range. Included for comparative purposes is the calculated response of a 24-layer iron–plastic sandwich spectrometer of comparable g/cm^2 thickness. The calculated data include spatially dependent energy deposition, spatially integrated contributions to the total energy deposition, leakage and binding energies, scintillation pulse-height distributions including and excluding saturation effects, and correlations between different variables. Also included for several cases is the calculated Cherenkov response. (auth)

29551 MEASUREMENT OF THE PROPAGATION VELOCITY OF SINGLE PLASMA CHANNELS IN A SPARK CHAMBER FOR PARTICLE TRACK DETECTION. Timm, U. Hamburg; Univ. Hamburg (1972). 52p. (In German).

Thesis.

The velocity of growth of single tracks in a spark chamber is described. It is shown that in the pressure range $300 < p < 760$ torr the tracks propagate with the same velocity to the anode and cathode provided that E/p remains below an experimentally determined value. A rise of this value causes an asymmetry, which makes the chamber no longer suited for the track localization of ionizing particles. (GE)

29552 LOCALIZATION OF PARTICLE TRACKS BY ELECTRON DRIFT TIME MEASUREMENTS IN LARGE AREA PROPORTIONAL COUNTERS. Walenta, A. H. Heidelberg; Univ. Heidelberg (1972). 67p. (In German).

Thesis.

The possibility of determining, by measuring the electron drift time in proportional chambers, the position of the particle passage is demonstrated, i.e., the particle coordinate perpendicular to the direction of the counting wires. The accuracy of this position determination is about 0.3 mm. Also, the second coordinate can be determined with an accuracy of 3 mm. The electrostatic forces encountered in connection with the construction of large proportional chambers are widely compensated by electrical means in the drift chambers. Chambers as large as 1 m^2 have been built up to now, which have been operating without malfunction in radiation fields of 10^4 particles/m^{2}s at the CERN Proton Synchrotron. (GE)

Radiometric Instruments

Refer also to abstract 29392.

29553 (JUL-1007-RX) VERSATILE GAS-ANALYSIS FACILITY FOR TECHNOLOGICAL USE. Jeltsch, E.; Graf, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Reaktorexperimente). Oct 1973. 23p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

In many technological problems a defined gas atmosphere is required which has to be controlled and maintained. A gas-analysis facility is described which is suitable for the analysis of inorganic gas components (O_2, N_2, H_2, CO, CO_2, Ar, Kr, Xe, Ne) and lower hydrocarbons in the concentration range of 0.1 ppM to approximately 100% in helium or another base gas. The complete arrangement consists of a gas-chromatographic and a mass-spectrometric measurement part. A Varian-2-channel gas chromatograph with helium ionization detectors for the trace analysis and an additional ultrasonic detector for higher gas concentrations are used, which are supplemented by some additional devices (e.g., systems for the tempering of the separation columns). A quadrupole mass spectrometer with high sensitivity for partial pressures extends the possibilities of gas-chromatographic analysis. Details of the facility are described and some applications are discussed. (GE)

29554 CONTAMINATION PROBLEMS WITH ^{63}Ni ELECTRON CAPTURE DETECTORS. Gosselin, C.; Martin, G. B.; Boudreau, A. (Laval Univ., Quebec). J. Chromatogr.; 90: No. 1, 113-118 (13 Mar 1974).

A study was performed on two ^{63}Ni electron capture detectors operating in dc mode. Several parameters have been examined. It appeared that the temperature difference between the detector and the column is important. Scavenger gas temperature and detector isolation are not less important. Furthermore, the detector polarization switch must always be off when no chromatogram is being run. These modifications help to keep the detector sensitivity much longer, with a consequent reduced number of washings. (auth)

29555 MEASUREMENT OF VOID FRACTION IN A FREE SURFACE FLASH EVAPORATOR BY MEANS OF GAMMA RAY ATTENUATION. Giger, W. Jr. Storrs, CT; Univ. of Connecticut (1973). 229p. University Microfilms Order No. 73-24,401.

Thesis (Ph.D.).

In a single stage of a free surface flash evaporator operating at 212°F and a flashdown of 3.5°F, the void fraction, temperature, and selected velocity profiles were measured. The void fraction was measured by gamma ray attenuation, using 0.5 Ci cesium-137 as a source and a scintillation detector and single channel analyzer for data collection. Temperatures were measured by thermocouples and velocities by pitot tubes. Well-defined heat transfer by turbulent thermal conductivity appeared to occur in the bottom half of the hydraulic jump. The turbulent thermal conductivity ranged from 530 Btu/hr-ft-°F along the bottom of the stage to 80,000 Btu/hr-ft-°F in the flow field. Low level turbulent heat transfer probably occurs in the channel flow region. In other regions, heat transfer against the temperature gradient occurred, indicating phase-change and convection are the principal heat transfer means. It was concluded that an uncovered hydraulic jump hinders efficient vapor release. Thin sheets of water are very effective for vapor production and release. The analysis of the test data shows that the test stage was not operated under optimum flow conditions; however, the factors affecting optimal stage operation have been identified. (Diss. Abstr. Int., B)

29556 CONTAINER FILL WEIGHT CONTROL USING NUCLEAR RADIATION. Ledgett, L. A. (to Colgate-Palmolive Co.). US Patent 3,796,873. 12 Mar 1974. Filed date 3 May 1971. 6p.

An apparatus for maintaining a desired weight for individual containers including radiation means spaced from a conveyor unit for irradiating filled containers is described. Suitable detection means are used to actuate a filler corresponding to a signal from an irradiated package and based upon a predetermined standard of absorption; the filling of later packages is controlled. (Official Gazette)

29557 CHARACTERISTICS OF A NEUTRON MOISTURE GAUGE WITH A SOLID STATE DETECTOR. Nagpal, M. K. (Kurukshetra Univ., India); Mehta, P. P.; Nagpaul, M. K.; Rama. Pramana; 1: No. 2, 112-116(Aug 1973).

Last author last name only.

The development of a neutron moisture gauge, using ^{252}Cf as a source of fast neutrons and muscovite as a detector of thermal-neutron-induced-fission in ^{239}Pu target, is reported. The laboratory and the field calibrations of the instrument reveal a linear relation between track count rate and the moisture volume fraction. Low cost, low weight, simplicity of operation, thermal stability and elimination of electronic equipment and power supplies are the attractive features of this instrument. The main drawback is its poor detection efficiency for thermal neutrons and the consequent unsuitability as a routine logging instrument. Its special features make it particularly suited to deep borehole logging such as in oil exploration. (auth)

29558 RADIATION GAUGE TO MEASURE THE THICKNESS OF VERY THIN FILM. I. Yamashita, T.; Momoi, T. (Kumamoto Univ., Japan). Kumamoto Daigaku Kyoikugakubu Kiyo, Shizenkagaku; No. 20, 1-6(Feb 1972). (In Japanese).

Characteristics of a β-ray backscatter thickness gage were investigated using ^{14}C as the radiation source. The results of the analysis show that the gage of this type is useful especially for the measurement of the thickness of thin metal films produced by vacuum evaporation. (auth)

29559 NEUTRON INELASTIC GAMMA RADIATION WELL LOGGING METHOD AND APPARATUS WITH BACKGROUND ACCOUNTED FOR. Smith, H. D. Jr. (to Texaco Inc.). US Patent 3,796,877. 12 Mar 1974. Filed date 10 Jan 1973. 30p.

Methods and apparatus are provided for making improved pulsed neutron-derived measurements of the carbon:oxygen ratio in subsurface earth formations. Plural radiation measurements are made as a function of time from the initiation of the neutron

pulse to distinguish inelastic and thermal neutron interactions. These measurements are also, within their respective time functions, energy dependent. The time and energy-dependent radiation measurements are then combined in several different manners to provide an improved carbon : oxygen ratio measurement and multiple porosity and formation lithology indication measurements. (Official Gazette)

29560 SEMI-EMPIRICAL METHOD OF DEFINING OF THE CALIBRATION CURVE FOR ISOTOPIC PROBE TYPE WO-65. Muras, K. (Technical Univ., Lodz, Poland). Arch. Hydrotech.; 19: 255-267(1972). (In Polish).

A new method of semi-empirical calibration of Type WO-65 cadmium probes is presented. The probes are designed for measuring the moisture in soil carried out in steel tubes of 35 to 38 mm diameter. The calibration consists of defining a relation of the probe reading and the volumetric moisture of a medium. The method is based on the dependence of empirically found probe readings and a calculated thermal neutron flux. Research showed that there exists a rectilinear independence between them in the range of volumetric moisture 0.05 to 0.40 g H_2O/cubic centimeter, thus practically covering the whole range of moisture of inorganic soils. Using the discussed method, it is possible to get calibration curves of an accuracy of about 0.01 to 0.02 g H_2O/cubic centimeter with isotopic probes. (WHK)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 29261, 30018, 30170, and 30180.

29561 (UCID-16460) INFORMATION RECOVERY FROM HIGH-SPEED SILVER HALIDE EMULSIONS CONTAINING CRT TRACES AFTER EXPOSURE TO NUCLEAR GAMMA RADIATION. Dittmore, C. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Mar 1974. Contract W-7405-eng-48. 19p. Dep. NTIS $4.00.

A data recovery problem often occurs in nuclear tests when photographic film used to record CRT traces is unavoidably exposed to gamma rays before it can be retrieved for developing. Studies made to improve recovery of the CRT data from such film are described. Best results were obtained with a procedure involving reversal processing, silver intensification, dye-coupling development, and duplication. (auth)

29562 ANNEALING MODEL FOR LITHIUM-DOPED SOLAR CELLS. Horne, W. E.; Madaras, B. K.; Russell, D. A. (Boeing Aerospace Co., Seattle). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 250-255(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

A study has been performed on P/N lithium doped silicon solar cells to develop a mathematical model for the annealing of radiation damage. Experiments with low energy protons (0.25, 1.0, and 2.0 MeV) indicate that the annealing rates of proton damage are a function of the local position of damage within the solar cell base. Compton electron studies were used to determine introduction rates for annealable and unanneable damage. Pulsed 10 MeV electron tests permitted the observation of short circuit current recovery from 1 to 10^5 seconds for comparison with the mathematical model. These data are used as inputs into a diffusion limited reaction model of the defect annealing phenomena. Nonuniformities of the dopant profiles within the solar cell base are accounted for by a two-region model of the solar cell base. The two-region model of the solar cell using the diffusion limited reaction theory of annealing yields equations which describe the short circuit current recovery in lithium doped solar cells very well for both electron and proton damage. (auth)

29563 PHOTON INDUCED DEGRADATION OF ELECTRON AND PROTON IRRADIATED SILICON SOLAR CELLS. Crabb, R. L. (European Space Research and Technology Centre, Noordwijk, Holland). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 243-249(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Infra red photon-induced electrical performance degradation of several types of commonly used silicon solar cells has been studied with respect to 1 MeV electron fluence dependence, photon intensity, dopant atom type and concentration, and silicon growth (crucible grown or float zone). Proton irradiated cells have also been studied. Laboratory electron-photon degradation data are compared with flight data from the ESRO satellite HEOS Al and the U. K. Satellite PROSPERO. The culprit minority carrier recombination centres remain, as yet, unidentified but it has been found possible to fabricate stable silicon solar cells by employing either high quality, low dislocation density silicon or aluminium rather than boron doped base silicon. (auth)

29564 TEMPERATURE DEPENDENCE OF DAMAGE COEFFICIENT IN ELECTRON IRRADIATED SOLAR CELLS. Faith, T J. (RCA Astro, Princeton, NJ). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 238-242(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Measurements of light-generated current versus cell temperature on electron-irradiated n/p silicon solar cells show the temperature coefficient of this current to increase with increasing fluence for both 10Ω-cm and 2Ω-cm cells. A relationship between minority-carrier diffusion length and light-generated current was derived by combining measurements of these two parameters: 1) versus fluence at room temperature, and 2) versus cell temperature in cells irradiated to a fluence of $1 \times 10^{15} e/cm^2$. This relationship was used, together with the light-generated current data, to calculate the temperature dependence of the diffusion-length damage coefficient. The results show a strong decrease in the damage coefficient with increasing temperature in the range experienced by solar panels in synchronous earth orbit; i.e., 200 to 330°K, and a significant temperature dependence of the ratio of the damage coefficient for 2Ω-cm cells to that for 10Ω-cm cells. (auth)

29565 EQUIVALENT FLUENCE AND RELATIVE DAMAGE COEFFICIENT TOOLS FOR SPACE SOLAR CELL DEGRADATION ESTIMATES. Tada, H. Y. (TRW Systems Group, Redondo Beach, CA). IEEE (Inst. Elec Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 234-237(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

An improved technique for estimating solar cell degradation in a space environment is presented. The equivalent fluence is defined and the relative damage coefficients are evaluated for solar cell output parameters with approximations appropriate for the use of normal incident experimental data. The equivalent fluences are calculated for sample cases to demonstrate the degradation of I–V curve. (auth)

29566 OXIDE CHARGE TRAPPING INDUCED BY ION IMPLANTATION IN SiO_2. Harari, E.; Royce, B. S. H. (Princeton Univ., NJ). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 288-292(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Experimental measurements directed at understanding oxide modifications induced by Na^+ and Al^+ ion implantation for radiation hardening of Si MIS devices are described. Both implanted species created high dark conductivity in unannealed specimens. This had a temperature dependence independent of ion type suggesting that the conductivity is related to displacement damage. Internal photoemission studies showed that Na^+ implantation had produced a barrier lowering at both interfaces and also permitted sub-threshold photoemission starting with photons of about 1 eV. Thermal annealing returned the oxide to its insulating state and removed the sub-threshold photoemission. Photodepopulation measurements indicated that the oxide still contained electron traps not present in the unimplanted samples. (auth)

29567 ANALYTICAL SOLUTIONS OF PRESSURE EFFECTS UPON CURRENT TRANSMISSION ACROSS A DIODE. dePlomb, E. P. (Intelcom Rad Tech, San Diego, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 20-25(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Space-charge limiting of current transmission can be neutralized by introducing gas into the diode. The relationship between gas pressure and transmitted current is determined by a combination of several basic physical processes. A model that can predict experimental observations over a wide range of pressures is utilized to show which processes dominate current transmission in various pressure ranges of interest. The quantitative analytical solutions of this model can be correlated with experimental results to yield effective values for secondary electron production, secondary electron drift velocity, electron range effects, and ionization avalanche. (auth)

29568 PRESSURE EFFECT ON SPACE-CHARGE-LIMITED CURRENT TRANSMITTED ACROSS A CYLINDRICAL CAVITY. Stahl, R. H.; dePlomb, E. P.; Wenaas, E. P.; Mallon, C. E. (Intelcom Rad Tech, San Diego, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 26-30(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Experimental data on space-charge dissipation due to gas effects has been obtained using electron pulses from an accelerator injected directly through a thin film and a metal screen into a small experiment chamber. The current transmitted across the chamber was measured as a function of gas pressure, gas composition, chamber depth, and electron collector impedance. The measurements generally confirm the theory developed by dePlomb in a companion paper at this conference. Several problem areas are noted that require further investigation. (auth)

29569 IEMP CABLE COUPLING PHENOMENOLOGY IN SMALL ENCLOSURES. Edelman, D. (General Electric Co., Philadelphia); Chadsey, W. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 31-39(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Experiments were performed to measure IEMP coupling to cables in small cavities for non-space-charge limited conditions. The experiments were designed to separate the magnetic field, electric field, and charge deposition coupling modes. Investigations were made of the effects of cavity pressure, cable bias potential, and cable type and termination. A theoretical model was developed which represents the various coupling modes by voltage and current sources in a lumped-parameter equivalent circuit. Theoretical predictions were compared to the experimental data. For the configurations investigated the predictions agree with the data to within the experimental uncertainty. (auth)

29570 DAMAGE SUSCEPTIBILITY OF INTEGRATED CIRCUITS TO A SIMULATED IEMP TRANSIENT. Vault, W. L. (Harry Diamond Labs., Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 40-47(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Recent investigations have been directed toward gaining insight into the effect of electrical pulse overstressing in integrated circuits, especially simple gates and bipolar LSI arrays. In order to determine the effect of ionizing radiation on the pulse-power failure susceptibility levels of small scale, monolithic, junction-isolated integrated circuits (simple gates), an experimental study was undertaken such that device failures could be induced in a simulated EMP or IEMP environment. The device types investigated included low- and high-power, quadruple, dual-input, positive NAND TTL gates. Permanent damage levels for these devices were determined for both positive and negative-polarity submicrosecond pulses, introduced into the input, output and bias terminals of active devices, some of which were simultaneously irradiated by gamma radiation. The radiation dose rates ranged from 1×10^{10} to 5×10^{10} rads(Si)/sec. The failure susceptibility level of a device was found to depend uniquely upon the ionizing radiation, the device terminal subjected to the electrical stress pulse, and the polarity of the pulse. The data for device failures in the simulated EMP environment agree with the existing thermal-failure models characterized by $P = At^m$, where P is the power required to induce failure and t is the time to failure. In a radiation environment it was observed that initial ionization tends to reduce the magnitude of the constant A and shifts the time to failure t from the constant-energy regime ($m = -1$) to another. (auth)

29571 IEMP STUDIES OF A DIELECTRIC-FILLED CAVITY: A COMPARISON OF EXPERIMENT AND THEORY. Brumley, F. B.; Evans, D. C.; Mangan, D. L. (Sandia Labs., Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 48-57(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The electromagnetic response of a dielectric-filled finite-length cylindrical cavity, exposed end-on at the Hermes II radiation facility, is experimentally and theoretically examined. Loop sensors were used to obtain azimuthal magnetic field related signals, and a dipole grid sensor was employed to acquire axial electric field related signals. The favorable comparison achieved between the experimentally obtained signals and the theoretically predicted results lends credence to the theoretical model developed. (auth)

29572 RADIATION INDUCED CURRENTS IN SUBMINIATURE COAXIAL CABLES. Bernstein, M. J. (Aerospace Corp., El Segundo, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 58-63(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Subminiature coaxial cables smaller than RG-58 were exposed to intense pulsed irradiation from a plasma focus device, and the currents induced on the center conductors were measured in a vacuum environment. The incident photons had energies mostly below 70 keV, and filters were used to vary the average hardness of the irradiation. The measured cable responses in units of Coulomb/rad(Si)-cm were compared to values calculated on the basis of photoemission from metal surfaces and electron ranges in insulators. It was found that the currents induced on the center conductors were several times larger than predicted for an ideal coaxial geometry because of small gaps between the dielectric surface and overlapping braid wires. For a given cable type, such as RG-174/U, large variations in cable responses were found according to each manufacturer's construction techniques. (auth)

29573 MULTIPLE DIELECTRIC RELAXATION TIMES IN AN IRRADIATED TRANSMISSION LINE. Marx, K. D. (Sandia Labs., CA). Contract AT(29-1)-789. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 64-71(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The theory of multiple dielectric relaxation times in an irradiated transmission line is developed in detail for strip lines and coaxial lines. The problem of deposition profiles, photo-Compton currents, and dielectric properties which vary arbitrarily is treated first; then the treatment is specialized to layered dielectrics. A numerical scheme is given for solving the resulting system of equations describing wave propagation on a line with layered dielectrics. The generalization to a shielded strip line (a three-conductor line) is also presented. (auth)

29574 TRANSMISSION LINE MODELS FOR USE WITH CIRCUIT/SYSTEM ANALYSIS PROGRAMS. Lubell, J. I.; Meixer, S. M. (TRW Systems, Redondo Beach, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 72-81(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Techniques for modeling multiconductor transmission lines for use with the SCEPTRE computer program are presented. The transmission line models developed can be modified for compatibility with other circuit/system transient analysis programs and are amenable to modification to include nuclear weapon effects. The general modeling approach has been to develop computationally efficient and accurate terminal models which can be arbitrarily loaded at the source and load ends and which can be used in conjunction with nonlinear electronic circuit models using either simplified or discrete modeling techniques. The concept of the method is to derive a set of transfer functions in the Laplace domain relating forward and backward traveling waves on the line to voltages and currents at the source and load ends of the line, approximate the transfer functions with a set of orthonormal polynomials, and represent the resulting rational polynomials in the time domain with state variable differential equations. For the multiconductor case, the orthogonal characteristics of wave propagation are used to decouple the modes of propagation except at the source and load boundary condition circuits. (auth)

29575 RADIATION DAMAGE INDUCED TIME DELAY IN GaAs LASERS. Schroeder, J. O. (Battelle Pacific Northwest Labs., Richland, WA); Noel, B. W.; Southward, H. D. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 261-265 (Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Fast-neutron irradiation induced time delays in the turn-on of the optical output pulse of diffused GaAs laser diodes have been observed. The results are explained using a double-acceptor model that predicts the delay's functional dependence on fluence and that also accounts qualitatively for the observed temperature dependence of the delay. Little neutron damage induced change occurs at LN_2 temperature, where the delay is thought to be a result of the time required to establish the population inversion, the double-acceptor traps being inactive. At high temperature the increase in delay with fluence appears to be caused by introducing more traps at a rate proportional to the number already existing. A "pivot" operating point can be found at which the diode time delay is almost unaffected by damage to $>10^{14}$ n/cm^2 (>10 keV). (auth)

29576 MEASUREMENT OF NEUTRAL BASE LIFETIME IN NEUTRON-IRRADIATED TRANSISTORS. Sanga, M. M.; Oldham, W. G. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 266-273(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

New data are reported for the neutral bulk lifetime of electrons in neutron-irradiated p-type silicon. The measurements are made in special uniform-base transistors and n^+p gated diodes. The resistivity range of 0.2 to 9Ω-cm is covered. In the higher resistivity samples, injection levels of slightly greater than unity are achieved. A range of neutron fluences from 10^{13} to 10^{15} n/cm^2

(E > 10 keV) is examined and the lifetime damage constant is found to be fluence independent. The data are compared with previous bulk and solar cell measurements. (auth)

29577 ANOMALOUS DAMAGE MECHANISM IN PNP SILICON TRANSISTORS DUE TO THERMAL NEUTRONS. Arimura, I.; Rosenberg, C. (Boeing Aerospace Co., Seattle). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 274-279 (Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Very low energy neutrons (E < 1 eV) were found to produce damage to pnp silicon transistors comparable to that produced by fast neutrons (E > 10 keV). The effectiveness of thermal neutrons was quite varied; ratios of thermal-to-fast neutron damage constants from less than 10^{-2} to nearly unity were obtained. The damage mechanism was tentatively identified to be the result of a $[^{10}B(n,\alpha)^{7}Li]$ reaction in the emitter region of the device whereby energetic alpha and Li particles are emitted and subsequently produce damage in the base region of the device. The role of the lithium recoil was identified to be responsible for the large observed damage ratios; however, even larger ratios are possible for certain types of devices. (auth)

29578 EFFECTS OF ELECTRON AND HOLE TRAPPING ON THE RADIATION HARDNESS OF Al_2O_3 MIS DEVICES. Harari, E.; Royce, B. S. H. (Princeton Univ., NJ). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 280-287(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The radiation sensitivity of MIS capacitors with pyrohydrolytic Al_2O_3 insulators has been investigated for x-irradiation at 300 and 80°K. Both x-rays and light of various photon energies were used to vary the populations of electron and hole traps inherent in the "as prepared" films. The energies of the trapping levels have been determined and the spatial distribution of the electron traps within the oxide estimated. These traps together with an SiO_x layer at the semiconductor-oxide interface are shown to control the device behavior under ionizing radiation. (auth)

29579 LATCH-UP IN CMOS INTEGRATED CIRCUITS. Gregory, B. L.; Shafer, B. D. (Sandia Labs., Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 293-299(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The parasitic transistors and pnpn paths present on junction-isolated CMOS circuits have been identified and studied quantitatively. Active SCR structures exist which can be triggered electrically or by a radiation pulse. Detailed studies of SCR paths have been performed on two circuits, the CD4007A and the CD4041A, to relate geometrical and materials parameters to latch-up sensitivity. Both normal bias conditions and bias optimum for obtaining SCR action are employed. Several techniques are proposed to eliminate radiation-induced latch-up in future CMOS designs. (auth)

29580 RADIATION FAILURE MODES IN CMOS INTEGRATED CIRCUITS. Burghard, R. A.; Gwyn, C. W. (Sandia Labs., Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 300-306(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The radiation sensitivity of commercial and laboratory CMOS processes has been investigated. Failure levels for CMOS circuits have been related to transistor threshold voltage shifts and typical inverter failure modes. CMOS inverter characteristics have been measured as a function of the ionizing radiation exposure for devices fabricated by 10 different manufacturers and representing a total of 15 different processes. By selecting certain processes, CMOS circuits can be obtained which will operate after exposure to an ionizing radiation dose greater than 10^5 rads (Si). (auth)

29581 ROOM TEMPERATURE ANNEALING OF IONIZATION-INDUCED DAMAGE IN CMOS CIRCUITS. Habing, D. H.; Shafer, B. D. (Sandia Labs., Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 307-314(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The effects of ionization on MOS devices as a function of time after exposure to a radiation source are functions of the radiation source and device bias time profiles. A discussion, supported by a comprehensive series of experiments, of the time dependence of ionization-induced damage to complementary metal oxide semiconductor (CMOS) devices is presented. Two distinct annealing or recovery mechanisms were investigated: (1) room temperature annealing in the absence of radiation, and (2) radiation enhanced room temperature annealing. Experiments were performed using both electron and γ-ray sources with ionization rates ranging from 10^3 rads(Si)/sec to greater than 10^{11} rads(Si)/sec and observation times extending from 1 msec to 10^5 seconds. The experiments demonstrate that ionization-induced damage to positively biased MOS devices, such as the n-channel devices in CMOS circuits, can be annealed appreciably at room temperature by additional irradiation of the device with zero gate bias. Thus, when operation of CMOS circuitry during or immediately following radiation exposure is of interest, the experimental semipermanent-type radiation damage data typically reported must be carefully evaluated. (auth)

29582 TRANSIENT PHOTOCURRENTS IN SOS STRUCTURES. Kjar, R. A.; Kinoshita, G. (Rockwell International, Anaheim, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 315-318(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Silicon-on-Sapphire (SOS) construction reduces junction photocurrents to such low levels that other radiation-induced currents tend to dominate the response of an SOS circuit to transient ionizing radiation. The results of experiments and calculations suggest that photoconduction of the sapphire substrate accounts for most of the observed "excess" currents internal to these circuits while gas ionization effects are significant at the external device terminals. (auth)

29583 TOTAL DOSE EFFECTS OF IONIZING RADIATION ON MOS STRUCTURES AT 90°K. Nielsen, R. L.; Nichols, D. K. (Rockwell International, Anaheim, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 319-325(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Experimental data at 90°K for chromium-doped and undoped MOS structures are presented. The data include the ionizing-dose dependence of the flat-band voltage of MOS capacitors and of the turn-on threshold voltage and forward transconductance of MOS transistors for several conditions of applied bias. Also included are isochronal annealing data for the threshold voltage of MOS transistors. The cryogenic data are interpreted in terms of Mitchell's theoretical model which relates the increase in susceptibility of MOS structures to ionizing radiation at 90°K to an order of magnitude increase in the $\mu\tau$ product of radiation induced electrons in the oxide. (auth)

29584 MEASUREMENT OF THE NEUTRON ENERGY DEPENDENCE OF BASE CURRENT DEGRADATION OF A SILICON BIPOLAR TRANSISTOR. McKenzie, J. M.; Witt, L. J. (Sandia Labs., Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 341-348(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

A measurement of the neutron energy dependence of base current of a small signal bipolar transistor is given. The theory of the method, the neutron radiation damage calibration and measurement, the neutron dosimetry, and an experiment to test the concepts and to obtain preliminary results are described. (auth)

29585 EXPERIMENTAL NEUTRON DAMAGE EQUIVALENCES UTILIZING DEVICE PARAMETERS. Coppage, F. N. (Sandia Labs., Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 349-353(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

When considering neutron-induced damage to transistors, it is desirable to relate the damage caused by one spectrum to that of another. Recent experimental work shows that the damage curves based on displacements in bulk silicon are an oversimplification when applied to devices, and give significant errors. Using the experimental technique described, it is possible to compare the damage of different spectra using the actual device parameter of prime interest. Results obtained using this technique show that damage induced in devices involves several damage mechanisms and is more complex and severe than that predicted from displacements alone. While damage ratios for different spectra may be quantitatively obtained, a totally satisfactory explanation for the increasing damage for spectra becoming increasingly "harder" is not presently available. The difficulty of explaining the damage ratios obtained that are larger than anticipated is compounded by the fact that these ratios appear to be dependent upon the operating point of the device, the device parameter used as a basis, and possibly the device type. (auth)

29586 HARDNESS ASSURANCE THROUGH LOT SAMPLING: HOMOGENEITY STUDIES. Millward, D. G.; Arimura, I. (Boeing Aerospace Co., Seattle). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 354-360(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

A study of the homogeneity of neutron response as a function of the level at which parts are sampled, i.e., over several diffusion runs, several wafers within a single diffusion run, a single wafer or parts within a wafer, is described. The results indicate that variations in neutron response across a wafer may be comparable to those of a diffusion run or production lot. However, homogeneity within an area comparable to that of a "standard" SSI integrated circuit is shown to be quite good and it appears that circuit neutron response can be predicted to ~10% by the use of 100% electrical screening of radiation correlation parameters on a specially bonded transistor within the IC chip (breakout transistor). Variations within an area on a wafer somewhat larger than that of an SSI chip are large enough to indicate that the breakout transistor approach may not be useful for prediction of the neutron response of MSI or LSI circuits. (auth)

29587 SIMPLE TRANSISTOR NEUTRON HARDNESS SCREEN USING SCATTERING PARAMETERS. Tausch, H. J.; Antinone, R. J.; Bailey, R. A. (Air Force Weapons Lab., Kirtland AFB, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 361-369(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

A frequency domain model of the common emitter S_{21} parameter of a junction transistor is derived which includes the effect of minority carrier transit time through the active device. Using this model it is demonstrated that the minority carrier transit time can be measured using scattering parameters. S-parameter derived transit time is used to predict neutron induced gain degradation. A prediction accuracy of approximately 5% is demonstrated. (auth)

29588 INVESTIGATIONS OF AN IRRADIATED-ANNEAL TECHNIQUE FOR NEUTRON HARDNESS ASSURANCE OF POWER TRANSISTORS. Arimura, I. (Boeing Aerospace Co., Seattle). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 370-373(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The results of an irradiate-anneal study for screening power transistors for neutron degradation are reported. The results of this study on 100 RCA TA8007 power devices indicated that very good predictions could be made for the neutron gain degradation, where the gains were measured within the capability of standard probe measurements. The observed neutron degradation of the package transistor gains closely matched that of the same transistors measured at the wafer stage, indicating that "soft" devices would be rejected prior to packaging if screens were imposed at the wafer stage. The optimum annealing condition for an irradiation fluence of 3.62×10^{13} n/cm^2 (E > 10 keV) was 350°C for four hours. Failure analyses (MTBF tests) indicated that the reliability of those devices is practically unaffected by the additional stresses required to implement an irradiate-anneal hardness assurance program. (auth)

29589 VARIATIONS OF NEUTRON DEGRADATION ACROSS WAFERS. Vail, P. J.; Mullis, J. L. (Air Force Weapons Lab., Kirtland AFB, Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 377-382(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The locally inhomogeneous neutron response of wafer nearest neighbor transistors and integrated circuits is demonstrated. Published data on irradiated silicon devices is reanalyzed to show the variation of neutron degradation which can typically be expected when no controls over base width are kept during device processing. Several 100% screens are suggested as alternatives to breakouts and sample screening. (auth)

29590 PERFORMANCE OF INJECTION LOCKED IMPATT OSCILLATORS UNDER TRANSIENT IONIZING RADIATION. Gutmann, R. J.; Borrego, J. M.; Cottrell, P. E.; Ghandhi, S. K. (Rensselaer Polytechnic Inst., Troy, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 388-391(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The performance of 500 milliwatt X-band injection locked IMPATT oscillators, exposed to 100 nanosecond pulses of 10 MeV electrons at dose rates between 1×10^8 and 3×10^9 rads/sec, is compared to free running IMPATT oscillators. The RF power reduction during the radiation pulse remained the same for the locked and free running oscillators, while the RF frequency shift depended upon the power of the locking signal. The locking figure of merit remained constant over the range of dose rates used, and original RF performance was regained within 50 nanoseconds following the radiation pulse. (auth)

29591 TRANSIENT CHANGE IN Q AND FREQUENCY OF AT-CUT QUARTZ RESONATORS FOLLOWING EXPOSURE TO PULSE X RAYS. King, J. C.; Sander, H. H. (Sandia Labs., Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 117-125(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Study of the transient behavior of AT-cut quartz resonators following pulse irradiation has been extended. In addition to 125 MHz 5th overtone crystal units previously reported, both 32 MHz and 5 MHz 5th overtone units have been studied using several different oscillator circuits, one of which is designed to give the transient resistance at series resonance, R_S, as well as frequency as a function of time after pulse exposure. R_S is proportional to the acoustic loss, i.e., Q^{-1}, of the resonator. With but one notable exception, the annealing kinetics of the transient frequency offset following pulse irradiation obeys a $t^{-\frac{1}{2}}$ relationship over three to four decades in time, indicative of a 1D diffusion limited trapping of uncorrelated mobile cation impurities in the crystal lattice. The most significant observation of the post-irradiation behavior of R_S is the relatively large R_S increase in natural quartz resonators. The transient increase anneals asymptotically to a relatively stable R_S value which is somewhat higher than the pre-irradiation R_S. The transient and steady-state post-irradiation change in R_S is frequency dependent and, based upon the underlying model, should also be temperature dependent. The increase of R_S in 5 MHz natural quartz resonators exposed to 10^4 rad from the Sandia Laboratories' Hermes II facility is 30 times its pre-irradiation value of 0.2 sec after burst. However, R_S for 32 MHz crystal units at 0.2 sec after exposure to 4×10^4 rad typically increases only a factor of 2 times the pre-irradiation value. Swept synthetic crystal units show no measurable post-irradiation change in R_S whatsoever. This fact, together with the absence of any delayed, or persistent, electrical conductivity in the swept synthetic unit following pulsed ionization, leads to the hypothesis that the transient as well as the steady-state R_S increase arises from an anelastic absorption caused by Li^+ and/or Na^+ which are able to move along the optic axis with an activation energy of approximately 0.3 eV—notably the same activation energy as that observed for the delayed conductivity and for the thermal bleaching of part of A-band color centers in natural quartz. When R_S becomes very large, it can have two effects on the resonator frequency: (1) negative $\Delta f/f$ due to stress relaxation and (2) a $\Delta f/f$ whose sign depends on the transfer phase angle in the active part of the oscillator loop. Finally, it has been discovered that the transient $\Delta f/f$ can be made negligible in crystal resonators made from quartz swept in an inert atmosphere. (auth)

29592 DOSE AND DOSE RATE DEPENDENCE OF INDUCED CONDUCTIVITY IN DIELECTRICS. Leadon, R. E.; Mallon, C. E.; Green, B. A. (Intelcom Rad Tech, San Diego, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 126-128 (Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

By comparing results from a computer simulation with experimental data, it is shown that the radiation-induced electrical conductivity (σ) in a dielectric can be written in the form $\sigma = K(\gamma)\dot{\gamma}$, where $K(\gamma)$ is a dose-dependent coefficient and $\dot{\gamma}$ is the dose rate. The coefficient $K(\gamma)$ decreases with the dose (γ) due to the internal polarization fields created in the dielectric by the separation of positive and negative charges. (auth)

29593 PRE-IRRADIATION BIASING EFFECTS IN TANTALUM CAPACITORS. Boesch, H. E. Jr.; McGarrity, J. M. (Harry Diamond Labs., Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 129-136(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The radiation-induced voltage buildup in several types of moderate to high working voltage sintered slug Ta capacitors has been found to be significantly modified by the application of reverse bias (Ta electrode) prior to irradiation. Alteration of the internal field in the Ta_2O_5 dielectric caused reduced negative voltage buildups in Sprague capacitors and enhanced buildup in Kemet units. To a first approximation the effect varied with the duration of application of bias and reverse leakage through the capacitor at that bias. The effect is eliminated by irradiation of the shorted capacitor to approximately 60 krad(Ta) or by heating to 100°C for approximately 12 hr. Some back-to-back series pairs of Ta capacitors also showed radiation response changes after biasing. (auth)

29594 OPERATION OF ACOUSTIC SURFACE WAVE DELAY LINES IN A NUCLEAR ENVIRONMENT. Berg, N.; Speulstra, J. (Harry Diamond Labs., Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 137-143(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The operation of three types of surface wave acoustic devices; a lithium niobate delay line, a quartz pulse-compression filter and a quartz binary-phase-coded (BPC) delay line, in a nuclear environment is investigated. Neutron irradiation up to 5×10^{15} N/cm^2 (E > 10 keV) and exposure to 4×10^5 rads of ^{60}Co gamma rays result in no changes. Transient ionization radiation, occurring at the time when an electrical signal is being converted to acoustic energy, decreases the amplitude and changes the phase of the signal. Once the signal is transmitting in the device as acoustic energy it is generally unaffected by ionizing radiation up to 10^{11} rad(Si)/sec. However, in the case of the BPC device, functional operation is impaired above levels of 4×10^3 rad(Si)/sec. (auth)

29595 OPERATION OF TRAPATT OSCILLATORS UNDER TRANSIENT IONIZING RADIATION CONDITIONS. Borrego, J. M.; Gutmann, R. J.; Geipel, H. J.; Ghandhi, S. K. (Rensselaer Polytechnic Inst., Troy, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 144-148(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The performance of complementary (n^+pp^+) silicon TRAPATT diodes has been measured under transient ionizing radiation conditions in both evacuated and air-filled coaxial cavities. Twenty-five watt pulsed, 2.5 GHz oscillators were exposed to 100 nanosecond pulses of 10 MeV electrons at dose rates between 2×10^7 and 4×10^9 rads/sec. The RF power is unaffected below a critical dose rates, which is typically between 8×10^7 and 2×10^8 rads/sec. Above this critical dose rate the RF power is almost quenched entirely during the radiation pulse, but recovers to the original level within 50 nanoseconds afterwards for all dose rates used. Rapid recovery of original RF power levels occurred when the radiation pulse occurred at the initiation of the 300 nanosecond RF TRAPATT pulse, in the middle of the TRAPATT pulse, or during the decay of the TRAPATT pulse. The RF power during the radiation pulse is in agreement with a first order model of TRAPATT operation, in which the principal effect of the radiation pulse is a reduction in mobile charge generated by the avalanche shock front. The decreased mobile charge reduces the time required to remove the trapped plasma and the time necessary for recovery of the diode voltage, thereby decreasing TRAPATT power. (auth)

29596 BURNOUT OF JUNCTION FIELD EFFECT TRANSISTORS. Long, D. M.; Swant, D. H. (General Electric Co., Philadelphia). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 149-157(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The results of a study on burnout characteristics of n-channel silicon junction field effect transistors as established by electrical pulse injection tests and high dose rate radiation tests are presented. For reverse biased pulse injection tests on JFETs connected in a diode configuration (source and drain tied together), current-mode second breakdown was observed at short failure times ($t_f < 0.1\ \mu s$) while thermally-induced second breakdown occurred at longer times. The high voltage JFETs tested were found to be much more susceptible to reverse bias pulse injection damage than were the low voltage JFETs (attributed to surface effects). When the gate lead of an actively biased device was driven with a forward biased pulse, the JFET failed due to heating in the pinchoff region of the channel causing a drain-gate short. Under flash x-ray radiation tests, the diode configuration exhibited photocurrent enhancement near the same current levels at which current-mode second breakdown occurred in the pulse injection tests, but higher power dissipation could be tolerated before device damage was incurred. When irradiated in the active configuration, the onset of photocurrent enhancement resulted in a sustained high current mode which persisted until metallurization burnout occurred. (auth)

29597 PERMANENT IONIZING RADIATION EFFECTS IN DIELECTRICALLY BOUNDED FIELD EFFECT TRANSISTORS. Neamen, D.; Shedd, W.; Buchanan, B. (Air Force Cambridge Research Labs., Bedford, MA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 158-165(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The permanent ionizing radiation effects resulting from the use of dielectrics to bound FET structures have been experimentally determined for a total ionizing dose up to 10^8 rads (Si) and for various dielectric isolation techniques. The experimental vehicles used for making these determinations were dielectrically isolated JFET's operated in such a manner that they behaved as a combination junction-MOS field-effect transistor. The experimental results observed by measuring the saturation current, turn-off voltage, maximum transconductance, and channel conductance of the junction FET show a non-monotonic relationship in the effects of a positive charge build-up in the silicon dioxide isolation dielectric with increasing dose. A theoretical model is derived for calculating the interface charge density as a function of the measurable JFET device parameters. (auth)

29598 IONIZING RADIATION EFFECTS ON GaAsP MIS CAPACITOR STRUCTURES. Kuhlmann, G. J.; Grannemann, W. W. (Univ. of New Mexico, Albuquerque). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 166-170(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The effects of ionizing radiation on GaAsP MIS capacitor structures fabricated using a thermally grown dielectric and a chromium gate are reported. The devices were irradiated with both ^{60}Co gamma rays and high-energy (0.5 < E < 2.2 MeV) electrons at doses ranging from 10^4 to 10^8 rads (GaAsP). Results of studies of charge buildup show that a net negative charge is trapped in the dielectric during irradiation; this contrasts with the positive radiation-induced charge trapping observed in silicon dioxide. Flat-band voltage shifts were less than 2 volts up to a dose of 10^8 rads (GaAsP). This compares favorably with shifts of greater than 10 volts which are noted in typical unhardened silicon structures under similar irradiation conditions. (auth)

29599 TRANSIENT RESPONSE OF EPITAXIAL GaAs JFET STRUCTURES TO IONIZING RADIATION. Ginell, W. S.; Zuleeg, R.; McNichols, J. L.; Notthoff, J. K.; Lehovec, K. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 171-179 (Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The transient response of epitaxial n-channel GaAs junction field effect transistors (JFETs) to ionizing radiation has been investigated. The devices were fabricated from epitaxial layers of n-type GaAs grown on a Cr-doped semi-insulating GaAs substrate. Prior to neutron exposure, the devices were observed to respond to and recover from the ionizing radiation very rapidly, indicating very short characteristic response times. The peak photocurrents in both the gate and drain circuits were observed to vary in proportion to radiation flux at low flux levels, but varied as the half power of flux at higher ionizing radiation rates. The magnitude of the photocurrents indicated that the previously insulating substrate was contributing a diffusion component to the photocurrent. The participation of the substrate in providing photocurrents was confirmed by application of a substrate bias which served to enhance or inhibit the photocurrent response, depending on bias polarity. To aid in interpretation of the complex phenomena observed in the epitaxial JFET structures, a number of more simple device structures were fabricated and their transient response to ionizing radiation was investigated. Neutron irradiation served to reduce the drain and gate photocurrents at all dose rates in the range 10^9 to 2×10^{11} rad (GaAs)/s but the observed prompt pulse shape was not altered appreciably by neutron exposure. Exponentially decaying photocurrent tails observed in the response of some structures were not present after neutron irradiation. Because of the very rapid recovery of GaAs JFETs to ionizing radiation, these devices should serve usefully in systems required to operate in a transient ionizing radiation environment. (auth)

29600 EFFECTS OF SHADOWS ON PHOTOCURRENT COMPENSATED INTEGRATED CIRCUITS. Vandre, R. H. (Aerospace Corp., El Segundo, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 180-184(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

Simple calculations show that high-z components such as wires, capacitors, and solder bonds can easily cast shadows with edges only 25 μm wide when illuminated with a low energy (E < 60 keV) x-ray beam. If one of these shadows falls between a photocurrent compensating diode-transistor pair, the mismatch in dose can drastically reduce the transient hardness of the integrated circuit. Results of pulsed x-ray tests on the Texas Instruments RSN 54L 71 R-S flip-flop and RSN 54L 00 quad two input nand gate showed that the upset threshold of a given state of the flip-flop was lowered by as much as a factor of 29 and the nand gate by a factor of 5.7. (auth)

29601 MINIMAL PHOTOCURRENT ANALOG MULTIPLEXER USING EDGE-ON DIODES. Tietze, F. C. (IBM Electronics Systems Center, Owego, NY); Sanera, A. E.; Vandre, R. H. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 185-189(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

An edge-on diode (EOD) is a dielectrically-isolated lateral PN junction diode formed in a thin (2 μm) layer of single-crystal silicon formed on an insulating substrate. EODs formed on sapphire have extremely low primary photocurrents because the junction areas and minority carrier lifetimes can be made very small. A 16-input analog multiplexer silicon on sapphire integrated circuit was fabricated to evaluate the EOD concept. The multiplexer met all electrical specifications and proved very fast, settling within 60 ns. While circuit radiation testing is not yet complete, individual diodes tested at a dense plasma focus x-ray source showed individual diode photocurrents of only about 100 μA/10^{11} rads (Si)/s. (auth)

29602 DYNAMIC INTERNAL ELECTROMAGNETIC PULSE CALCULATIONS IN THREE SPATIAL DIMENSIONS. Lopez, O.; Rich, W. F. (Kaman Sciences Corp., Colorado Springs, CO). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 14-19(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

When a photon pulse impinges on a cavity, it causes electrons to be emitted from the cavity walls, thereby producing electromagnetic fields in the cavity. This constitutes what is known as Internal Electromagnetic Pulse (IEMP). The produced fields for a given incident photon pulse and spectrum (in the case where transient space charge effects are important) are calculated by means of a particle-in-cell numerical simulation. The calculations are three-dimensional and fully electromagnetic. The calculated fields for pressures of 0.4 μ and 720 μ show good quantitative agreement with recent underground test results. Both the calculations and the experimental data show that the presence of background gas in the cavity greatly affects the magnitude of the fields in the cavity. At 0.4 μ the emitted current is heavily space charge limited and the magnetic fields are comparatively low. At 720 μ, the emitted currents ionize the background gas and the secondary currents neutralize the space charge barrier. Then, almost the full emission current traverses the cavity causing much higher magnetic fields. The space charge neutralization process causes the risetime of the fields to be shorter than that of the emitted currents. System implications of these phenomena are discussed. (auth)

Miscellaneous Instruments

Refer also to abstracts 29236, 29244, 29649, 29713, 29737–29740, 29742, 31186, 31262, 31393, 31651, and 31664.

29603 (ANCR-1129, pp 267-381) TECHNIQUES AND INSTRUMENTATION. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

29604 (BDX-613-1061) SPATIAL DISTRIBUTION FROM SMALL BETA SOURCES AND THE EFFECTS OF APERTURE SIZE. Technological Spinoff Report. Heckman, R. V. (Bendix Corp., Kansas City, Mo. (USA)). Feb 1974. Contract AT(29-1)-613. 28p. Dep. NTIS $4.50.

Using a film technique, the forward and backward distribution of small beta sources were studied. In addition, the effect of the ratio of aperture size to source size was investigated for commercial coaxial-type beta-backscatter probes. Experiments indicated that the signal-to-noise ratio for such probes is intolerable when apertures smaller than 0.020 in. (0.5 mm) are used. Test configuration, probe, and detector design changes for measurements on areas 0.005 in. (0.13 mm) in diameter are discussed. (auth)

29605 (FDA-73-8029, pp 415-418) MEASUREMENT OF TIMER ACCURACY ON X-RAY MACHINES. Lott, S. H.; Pagel, J. (Vanderbilt Univ., TN). Mar 1973.

In health physics in the healing arts.

29606 (FDA-73-8029, pp 430) SELECTION OF TECHNIQUE FACTORS FOR CAPACITOR ENERGY STORAGE X-RAY EQUIPMENT. Weaver, K. E.; Barone, G. J.; Denny, E. W. (Food and Drug Administration, Rockville, MD). Mar 1973.

In health physics in the healing arts.

29607 (FDA-73-8029, pp 431) RESPONSE OF DIRECT PRINT PAPER TO X RADIATION. Doering, M. D.; Weaver, K. E.; Showalter, C. K.; Denny, E. W. (Food and Drug Administration, Rockville, MD). Mar 1973.

In health physics in the healing arts.

29608 (HEDL-SA-649) REVIEW OF METHODS FOR MEASURING STAINLESS STEEL INTERSTITIAL ELEMENTS IN SODIUM-APPLICATION TO LMFBR'S. McCown, J. J.; Ballif, J. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1973. Contract AT(45-1)-2170. 30p. (CONF-740301-4). Dep. NTIS $4.50.

From NACE meeting–corrosion/74; Chicago, Illinois, USA (4 Mar 1974).

The current status of on-line monitors for measuring oxygen, hydrogen, and carbon in liquid sodium based on experiences gained in the Prototype Applications Loop is described. Data obtained using metal equilibration methods for measuring specific chemical activities are presented. (TFD)

29609 (IPP-9-15) CONSTRUCTION AND PERFORMANCE OF A MULTIPLE FOCUSING TIME OF FLIGHT MASS SPECTROMETER. Oetjen, G. H.; Poschenrieder, W. P. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jan 1974. 51p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

A new type of time-of-flight mass spectrometers (TOFMS) achieves first order energy-and directional focusing in time and space by combining linear drift spaces and electrical sector fields. The theory was extended to second order effects. Aberrations in focusing as well as the mass resolution were calculated as functions of the energy acceptance and the entrance angle. A multiple-focusing TOFMS with a flight path of 157 cm was constructed and aberrations in focusing were found to be in good agreement with the second order theory. For an energy acceptance of (ΔE/E) = 10%, radial and axial entrance angle of 2.5°, and a primary ion-pulse width of 65 ns a mass resolution of 150 was obtained. The advantages of the multiple-focusing TOFMS, such as large energy acceptance and optimal, absolute sensitivity are discussed and compared with linear and focusing TOFMS of different design, and a quadrupole and magnetic sector field spectrometer as well as a number of favorable applications for the multiple focusing TOFMS are suggested. (auth)

29610 (KHFTI-73-27) DEVELOPMENT OF EQUIPMENT FOR THE MAGNETIC FIELD MEASUREMENT OF THE ELECTROMAGNETIC ANALYZERS. Grishchenko, E. M. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1973. 39p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.00.

The development of equipment for magnetic field EMA measurements by the YaMR method is described. Pecularities of the YaMR method applications are considered; the questions, connected with automation and measurement accuracy, the schemes and magnetometer nodes are described. The work may be of great use to the operating staff of the charged particle accelerators and to the researchers on the measurement apparatus for the nuclei resonance. (auth)

29611 (LA-3196) NEW INSTRUMENT FOR URANIUM DETERMINATION IN ROVER FUEL ELEMENTS: EIGHT-INCH AND TWENTY-FOUR-INCH MODELS. Matlack, G. M.; Metz, C. F. (Los Alamos Scientific Lab., N. Mex. (USA)). 1 Dec 1964. Contract W-7405-eng-36. 33p. Dep. NTIS $3.75.

Declassified 28 Aug 1973.

The quantity of oralloy in a Rover fuel element section is determined by measuring the gamma-ray flux emitted by the section with a 4π scintillator detector which completely surrounds the section. The anode current from the multiplier phototubes is integrated over a precisely measured time interval, thus avoiding the difficulties encountered by pulse-counting techniques when dealing with extremely high disintegration rates. Tests with a 24-inch model have demonstrated a precision of 0.3% for a single determination performed in 100 s. A larger model is being constructed which will accommodate fuel elements up to 52 in. in length. (auth)

29612 (TID-26488) CAMAC: SERIAL SYSTEM ORGANIZATION. (USAEC, Washington, D. C.). Dec 1973. 67p. Dep. NTIS $5.45.

A Serial Highway for interconnecting CAMAC crates and a System Controller is described. The Serial Highway uses either a bit-serial or a byte-serial mode of transferring data and control information. Up to 62 crates may be accommodated. In addition, a Serial Crate Controller (SCC) is defined that may be used in either bit-serial or byte-serial mode, at the option of the user. (auth)

29613 (UCID-15789) SURVEY AND REVIEW OF LASER PULSE CALORIMETERS. Schultz, P. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jan 1971. 15p. Dep. NTIS $4.00.

The energy of a laser pulse is normally monitored by an integrating photodetector, which detects a small reflected portion of the beam. In order to give accurate results, the photodetector system must be calibrated by some standard reference calorimeter. The calorimeter is usually placed in the path of the beam to absorb all of the energy in the pulse for higher accuracy. When the calibration of the photodetector is complete, the calorimeter is removed from the system. If the splitter-photodetector system is moved or the path of the laser beam is altered, the calibration procedure must be repeated. It is, therefore, of importance to the user that the calorimeter has a fast response, gives easily interpreted outputs, is easy to insert in a system, and is not damaged by a high-power laser pulse. To assist in the decisions as to what type of calorimeter to use in a particular laser system, a review of the state of the art of laser calorimeters is presented. (WHK)

29614 SMALL ANALYTICAL QUADRUPOLE MASS SPECTROMETER DESIGNED FOR OPERATION IN HIGH AND ULTRA-HIGH VACUUM SYSTEMS. Holme, A. E.; Thatcher, W. J.; Leck, J. H. (Univ. of Liverpool). Vacuum; 24: No. 1, 7-11(Jan 1974).

From 3rd annual conference of the vacuum group of the Institute of Physics; London, England (30 Apr 1973).

The characteristics of a small quadrupole mass spectrometer are described in detail. These show that the requirements of an analytical instrument for use in high and ultrahigh vacuum systems have been met. The performance is adequate for the measurement of partial pressures down to and below 10^{-11} torr. This is achieved with constant sensitivity over the range 0 to 200 amu with a resolution adequate to separate completely individual peaks up to 50 amu. The instrument does not have an electron multiplier. The consequent disadvantages of a relatively slow response and a limitation to the minimum detectable pressure are compensated by a higher stability and a smaller, simpler, and reliable instrument. Observations with a number of units over a period of many months indicate a maximum change in sensitivity of any one and a difference between individual instruments to be of the order of $\pm 20\%$. This is therefore a gauge head of approximately the same size as a modulated BA gauge with the same sensitivity, stability, and baking characteristics. (auth)

29615 PULSE SPECTRA OF PHOTOELECTRONS IN PHOTOMULTIPLIERS. Ballini, J. P. (Univ., Paris). Nucl. Instrum. Methods; 116: No. 1, 109-121(1974).

FR.

Analyzing the histogram of anode pulse amplitudes allows a discussion of the hypotheses that have been proposed to account for the statistical processes of secondary multiplication in a photomultiplier (PM 56 DVP): a Poisson process, as was suggested by Lombard and Martin (1961), or a Polya process, as suggested by Prescott (1966). Comparison of experimental single-electron pulse spectra with calculated theoretical spectra is first performed by means of moment analysis, from which fractional variance, skewness (a measure of the asymmetry of the distribution), and excess of kurtosis (a measure of the sharpness of the peak and the extent of the tails, as compared with those of a Gaussian distribution), are deduced; then, by directly comparing the shapes of the spectra and minimizing the area between them. On the whole, this study on a focussed dynodes PM makes it clear that though a Polya process is a better approach to reality than a Poisson process, the gain distribution which it leads to does not correspond to the experimental spectrum. A better accord is obtained on assuming a dynode distribution including, in a first approximation, two Poisson distributions of distinct mean value and expressing an inhomogeneity of the secondary multiplication gain value different from that imagined by Prescott. (auth)

29616 ACCURATE MEASUREMENT OF CABLE DELAYS. Wilson, A. R. (London Univ.). Nucl. Instrum. Methods; 116: No. 1, 93-95(1974).

The development of a technique, first described by Kiesler and Righini, with which it is possible to measure cable delays of up to several hundred ns with an accuracy of ± 1 ps is described. (auth)

29617 USE OF A UNIVIBRATOR WITH CLEAR TO SIMPLIFY THE LOGIC OF A DIFFERENTIAL DISCRIMINATOR. Bayer, R. (Inst. of Nuclear Research, Swierk, Poland). Nucl. Instrum. Methods; 116: No. 1, 199-200(1974).

The logic of the differential discriminator is described. It is simplified by using a univibrator with clear, type 74122. (auth)

29618 SOVREMENNAYA YADERNAYA ELEKTRONIKA. Tom I. Izmeritel'nye Sistemy i Ustroistva. (Contemporary Nuclear Electronics. Volume I. Measurement Systems and Installations). Krasheninnikov, I. S.; Kurochkin, S. S. Matveev, A. V.; Rekhin, E. I. Moscow; Atomizdat (1974). 304p.

The principles of the theory of pulse and continuous random processes found in experimental physics, methods of analysis, and the construction of analog installations used in the measurements are reported. The basic analog measurement installations of nuclear physics are installations for the amplification and measurement of pulse amplitudes and the time interval between them, analog conversion of pulse beams, and determination of the spectral and correlation characteristics of beams. These installations are examined from the viewpoint of the optimum filtration obtainable with experimental signals. A synthesis is made of the optimum installations and an evaluation is given of the limiting possibilities because of internal and external noise. Specific examples are given of installations and their circuits and characteristics. (tr-auth)

29619 NEUTRON AND PHOTON FLUX FROM X-RAY FLUORESCENT THYROID SCANNERS. Robinson, E. L.; Hannah, B. O.; Bass, W. B.; Wills, E. L. (Univ. of Alabama, Birmingham). Health Phys.; 26: No. 4, 301-306(Apr 1974).

Systems using x-ray fluorescence for in vivo organ studies, especially thyroid scanning, are now in use at several institutions. The most commonly used sources of γ radiation for stimulating fluorescent iodine x-rays for thyroid scans are multicurie sources of ^{241}Am. Alpha particles from the decay of americium produce nuclear reactions in the source matrix and give rise to a fast neutron flux and γ rays. The neutron dose rate delivered to the eyes of a patient during a scan is less than 1 mrem/hr for a 5 Ci ^{241}Am source mounted inside a $\frac{1}{2}$ in. thick tungsten alloy source-collimator assembly and the γ-ray dose rate delivered to the patient's eyes from this source during a scan is less than 0.1 mR/hr. A typical fluorescent scan requires 20 to 30 min. (auth)

29620 THERMAL IONIZATION MASS SPECTROMETRY. Mathews, C. K. (Bhabha Atomic Research Centre, Bombay). Instrum. India; 6: No. 5, 19-21; 32(May 1971).

A brief description is given of the thermal ionization spectrometer used for isotope abundance measurements. Measurements carried out with this spectrometer on the $^{235}U/^{238}U$ ratio yield a precision of about 0.5%. The technique of isotope dilution in measuring isotope abundance is discussed. The applications of the isotope dilution technique in the fields of nuclear technology and geochemistry are mentioned. (INIS)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 29093 and 29284.

29621 (CONF-721111-, pp 86-91) LASER ISOTOPE SEPARATION AND CONTROLLED THERMONUCLEAR REACTORS. Altschuler, S. J. (Dow Chemical Co., Denver). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Laser isotope-separation methods that depend on differences in the absorption of light of a given wavelength by different isotopes or the molecules containing them possess, in principle at least, certain advantages that would be useful for the tritium handling problem. The advantages are large separation factors, low internal rates and holdup, the ability to selectively remove any desired isotope from a mixture rather than only the light one, and operating costs proportional to the amount of product rather than the amount of feed. (auth)

29622 (CONF-730985-, pp vp, Paper 11) VIEW OF ENRICHMENT PLANT TAILS ASSAY. Baranowski, F. P. (Atomic Energy Commission, Washington, DC). 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

Gaseous diffusion enrichment plant operating tails assay is discussed in relation to the enriched U requirements to the year 1985, compatibility of existing gaseous diffusion plants to support projected enrichment requirements, Pu recycle and tails assay effects, the nuclear power market, and the complexity of forecasting uranium resources. (LCL)

29623 METHOD FOR PRODUCING BARRIER IN USE OF URANIUM ENRICHMENT. Ikeda, H.; Kabayama, S. (to Sumitomo Electric Industries Ltd.). Japanese Patent 1973,3280. 13 Sep 1969. 1p. (In Japanese).

The method of producing filter for uranium enrichment according to the present invention is characterized by extracting a liquid pore-forming agent from a fluorine-contained resin sheet consisting of fluorine-contained resin powder, liquid poreforming agent, and inert metallic or inorganic fine divided powder. The inert fine powder must be inactive against uranium hexafluoride and its particle dimension must be below that of the fluorine-contained resin powder particle, for example below 0.5 μ preferable 0.08 μ. The favorable inert substances are gold, nickel, and alumina. In the examples given, 100 parts of tetrafluoroethylene resin F 103 (Daikin Co.) are mixed with 15 parts of Al_2O_3. The mixture is pressed in a die of 100 mm × 30 mm under a pressure of 30kg/cm^2. It is then extruded from an extruder whose slit dimension is 5 mm. The resulting extrusion (5.3 mm of dimension) is rolled to 0.05 mm. The substance is extracted by Freon 113 and dried. The separation factor of the resulting filter is 85% at a pressure of 50 mm Hg. (JA)

29624 TESTS ON EXPERIMENTAL GASEOUS DIFFUSION CASCADES FOR URANIUM ENRICHMENT. Higashida, Y. (Sumitomo Shipbuilding and Machinery Co. Ltd., Tokyo). Sumitomo Jukikai Giho; 20: No. 58, 24-27(Oct 1972). (In Japanese).

In order to measure the characteristics of a diffusion barrier for uranium enrichment, experimental multistage gaseous diffusion cascades (3, 9, and 13-stage) which were fundamentally designed by Rikagaku Kenkyusho (the Institute of Physical and Chemical Research) have been made and delivered to Rikagaku Kenkyusho. For these cascades very severe permissible leak rates and special procedures are required so as to handle UF_6 gas. Therefore, various kinds of leak detection methods and procedures of the fluoridation were used. These leak test methods and the procedures are described. (auth)

29625 DUAL PRESSURE-DUAL TEMPERATURE ISOTOPE EXCHANGE PROCESS. Babcock, D. F. (to United States Atomic Energy Commission). US Patent 3,792,156. 12 Feb 1974. Filed Date 21 Jun 1972. 8p.

A liquid and a gas stream, each containing a desired isotope, flow countercurrently through two liquid-gas contacting towers maintained at different temperatures and pressures. The liquid is enriched in the isotope in one tower while the gas is enriched within the other and a portion of at least one of the enriched streams is withdrawn from the system for use or further enrichment. The tower operated at the lower temperature is also maintained at the lower pressure to prevent formation of solid solvates. Gas flow between the towers passes through an expander-compressor apparatus to recover work from the expansion of gas to the lower pressure and thereby compress the gas returning to the tower of higher pressure. (Official Gazette)

29626 HEAVY WATER AND ITS PRODUCTION. Shimizu, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Doryokuro Giho; No. 7, 46-54(Apr 1973). (In Japanese).

Heavy water is important as the moderator and coolant for nuclear reactors and in the future as material for fusion reactors. For the heavy-water reactors, efforts to reduce production cost of the heavy water are significant. After briefing on the sources of heavy hydrogen, separation factor, and exchange reaction for the separation, those processes currently available with prospect for the cost reduction are described, namely hydrogen sulfide-water (GS process), ammonia-hydrogen, amine-hydrogen and water-hydrogen exchange methods, and distillation method. Because of reversible nature, the exchange reaction is most promising as industrial process; and the GS process will remain as such hereafter. If an industrial device of transferring ^2H from source water to hydrogen is realized, the ammonia-hydrogen, amine-hydrogen or hydrogen distillation method can be competitive with the GS process. (JA)

29627 GASDYNAMICS OF A CENTRIFUGAL MACHINE. Sakurai, T.; Matsuda, T. (Kyoto Univ.). J. Fluid Mech.; 62: No. 4, 727-736(27 Feb 1974).

Axisymmetric steady centrifugally driven thermal convection in a compressible fluid in a rapidly rotating circular cylinder is considered. The Boussinesq approximation is not used, because it is not valid for the case of practical interest. The importance of the effect of the flow-induced volume change of a fluid particle is clarified, and a widely applicable method of solution is proposed. (auth)

29628 PROSPECTS FOR GAS DIFFUSION IN EUROPE. Besse, G. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 103, 5-12(1973). (In French).

From Deutsches Atomforum; Frankfurt am Main, Ger. (26 Jun 1973).

Data on the growth of the uranium enrichment market are reviewed together with the need for a European enrichment plant. The technical problems posed by the development of a gaseous diffusion plant are discussed. Studies undertaken for the construction of a high-capacity plant are presented. (FR)

Isotopic Power Sources

Refer also to abstract 29433.

29629 (COO-2155-3) BIOMEDICAL ENGINEERING SUPPORT. Quarterly Progress Report. Kolff, W. J. (Utah Univ., Salt Lake City (USA). Dept. of Surgery). 15 Mar 1972. Contract AT(11-1)-2155. 29p. Dep. NTIS $3.50.

During the quarter covered by this progress report (December 15, 1971 to March 15, 1972), the effects of variations in arterial pressure and heart rate on cardiac output, efficiency as measured at the heart diaphragm, maximum air chamber pressure, average input power to the heart diaphragm, maximum blood chamber pressure and volumetric efficiency have been determined at various atrial pressures for a 7 cm base Kwan-Gett artificial heart made of smooth Silastic and equipped with Silastic flap inflow and Silastic tricuspid outflow valves. One animal experiment has been completed in which the in vitro measurements made on the artificial heart were verified in vivo. A second animal experiment in which the output power of the artificial heart will be determined over a long period of time is now in progress. Preliminary consideration has been given to the establishment of a nuclear powered artificial heart system in vitro test program. A preliminary design of an artificial heart to be driven by a nuclear engine has been drawn. (auth)

29630 (COO-2155-5) BIOMEDICAL ENGINEERING SUPPORT. Annual Report. Kolff, W. J. (Utah Univ., Salt Lake City (USA). Dept. of Surgery). 15 Jul 1972. Contract AT (11-1)-2155. 51p. Dep. NTIS $4.75.

The purpose of this research was to provide the artificial heart design information necessary for the proper development of an implantable nuclear power supply for the artificial heart.

A Kwan-Gett hemispherical artificial heart made of silicone rubber was attached to a mock circulation instrumented with pressure, volume and flow transducers and measurements made of power input to the artificial heart at various locations, source of power losses and efficiencies of the artificial heart under a variety of pumping conditions, volumetric efficiency, pressure required to move the diaphragm of the artificial heart, required motion of the heart diaphragm and pumping characteristics of the artificial heart. The in vitro measurements have been verified by in vivo experiments in calves. The preliminary design of a pumping chamber for the nuclear powered heart has been completed. (auth)

29631 (COO-2155-6) BIOMEDICAL ENGINEERING SUPPORT. Quarterly Progress Report. Kolff, W. J.; Backman, D. K.; Sandquist, G. M. (Utah Univ., Salt Lake City (USA). Dept. of Surgery). 15 Oct 1972. Contract AT(11-1)-2155. 23p. Dep. NTIS $3.25.

During the quarter covered by this progress report (July 15–October 15, 1972), the power requirements of a bench test heart pump were determined. Cardiac output response, peak pusher cup forces, and power efficiencies were also determined. These measurements were made in vitro. Several geometries of connectors for the heart pump were evaluated for fit in dead calves to determine a practical configuration. Two models of the nuclear engine were implanted in calves to evaluate the chronic effects of engine weight and size. (auth)

29632 (COO-2155-7) BIOMEDICAL ENGINEERING SUPPORT. Quarterly Progress Report, October 15, 1972–February 15, 1973. Kolff, W. J. (Utah Univ., Salt Lake City (USA). Inst. for Biomedical Engineering). 15 Feb 1973. Contract AT(11-1)-2155. 29p. Dep. NTIS $3.50.

During the quarter covered (October 15, 1972 to February 15, 1973), additional models of the nuclear engine were implanted in calves to evaluate the chronic effects of weight and size. Further characterization of the bench test heart pump was performed. The effect of pump rate on cardiac output was evaluated. The effect of outflow (arterial) pressure on cardiac output was evaluated. Bjork-Shiley valves with stainless steel disks and pyrolitic carbon disks were tested and the effect of cardiac output evaluated. A design of a quick connect system to enable rapid connection of the atrial cuffs and arterial graphs to the blood pump was undertaken. Molds of the implantable version of the ventricles were completed, and construction techniques and evaluation of the ventricles is now in progress. A protocol for the implantation of the pump mechanism into calves for testing is under consideration. (auth)

29633 (KFK-1933) MATERIALS FOR IMPLANTABLE HEAT SOURCES FOR CIRCULATORY ASSIST-DEVICES. Nazare, S. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Feb 1974. 29p. (In German). Dep. NTIS (U. S. Sales Only). $4.50.

Materials used in heat sources for circulatory assist devices are reviewed. The topics include the preparation of ^{238}Pu by irradiation of NpO_2 or AmO_2-Al-cermets; considerations for the choice of fuel compounds and cladding materials for the heat sources; and test parameters to determine the safety of such devices. A list of materials data that would assist in the design of such devices and enable an assessment of their safety is presented. (auth)

29634 (MLM-1600) SUMMARY REPORT ON SNAP-19B (IRHS) PROGRAM. Loyer, D. E.; Davenport, C. H. (Mound Lab., Miamisburg, Ohio (USA)). 27 Jun 1969. Contract AT-33-1-Gen-53. 117p. Dep. NTIS $9.00.

Declassified 30 Aug 1973.

Design and fabrication of SNAP-19B intact-upon reentry $^{238}PuO_2$ heat sources (IRHS) are described. (TFD)

29635 (MLM-2104) THERMAL SHOCK ANALYSIS OF CERAMIC MULTIHUNDRED WATT SPHERES. Tennery, V. J. (Mound Lab., Miamisburg, Ohio (USA)). 25 Mar 1974. Contract AT-33-1-GEN-53. 33p. Dep. NTIS $4.00.

The thermal fracture resistance of plutonia Multihundred Watt (MHW) fuel spheres was analyzed assuming boundary conditions of (1) constant heating or cooling rate for the sphere surface, (2) heating or cooling with a constant surface heat transfer coefficient at the sphere surface, and (3) heating or cooling the sphere surface solely by radiation. Thermal damage resistance (mechanical weakening) of MHW spheres was analyzed in terms of the fracture energy and crack system present in the fuel. Using available property data for porous PuO_2 between 400 and 1200°C, and estimating other properties from available data for UO_2 and ThO_2, the thermal shock conditions that cause fracture of the fuel sphere were estimated. Experimental values for the tensile fracture strength and the elastic modulus of the fuel as functions of temperature are presently not available and estimates were made of these properties. (auth)

29636 (MLM-2122) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: OCTOBER–DECEMBER 1973. (Mound Lab., Miamisburg, Ohio (USA)). 15 Mar 1974. Contract AT-33-1-GEN-53. 30p. Dep. NTIS $4.00.

Topics reported on during the reporting period include: removal of molybdenum from molybdenum-coated ceramic particles; oxidation of PPO fuel spheres during oxygen-16 treatment; and heat transfer and thermal conductivity of multihundred watt $^{238}PuO_2$ fuel spheres. (TFD)

29637 (MND-3062-26) HYPERVELOCITY PARTICLE BREAKUP: ANALYSIS AND EXPERIMENT. Feasibility Report. Osmeyer, W. E.; Olsen, T. M.; Braun, W. (Martin Marietta Corp., Baltimore, Md. (USA)). Jun 1966. Contract AT(30-1)-3062. 39p. Dep. NTIS $5.00.

During the reentry destruction of an isotopic generator, the mechanisms of fuel form ablation must be predictable to properly assess the nuclear hazard associated with the event. Ultimate land deposition patterns and contaminant densities are directly a function of the final ablative particle size. One mechanism of fuel form ablation is the mechanical breakup of molten material by aerodynamic forces created during hypervelocity reentry. The object of this study was to determine the feasibility of describing the breakup phenomenon by statistical mechanical analytic techniques, and to determine the applicability of employing a light gas gun and a controlled environmental range to experimentally observe the breakup phenomenon. (auth)

29638 (MND-3062-29) SOLUBILITY STUDY OF STRONTIUM FUEL COMPOUNDS. Gray, J. H. (Martin Marietta Corp., Baltimore, Md. (USA)). Jun 1966. Contract AT(30-1)-3062. 43p. Dep. NTIS $5.25.

Strontium titanate, distrontium titanate, and strontium fluoride have been considered as isotopic fuels in thermoelectric generators for space and terrestrial applications. Evaluation of the radiobiological and radioecological effects of accidental release of ^{90}Sr on land, in water, and in air requires a knowledge of the dissolution rates of the fuel in fresh water, salt water, and dilute HCl. Results of a study to investigate the behavior of these strontium fuel forms in the different test solutions are presented. (TFD)

29639 (PTB-ND-6) ^{238}Pu-SOURCE OF A THERMONUCLIDE BATTERY FOR A HEART PACEMAKER. Dietze, G.; Kluge, H.; Matzke, M.; Ramthun, H.; Siegel, V.; Zill, H. W. (Physikalisch-Technische Bundesanstalt, Braunschweig (F.R. Germany). Neutronendosimetrie). Feb 1974. 36p. (In German). Dep. NTIS (U. S. Sales Only) $5.00.

A description is given of measurements carried out on a $^{238}PuO_2$ source containing about 0.2q ^{238}Pu, which has been developed for a thermoelectric generator for a heart pacemaker. The γ-spectrum, neutron source strength and energy distribution, dose equivalent rate, exposure rate and the heat power, activity, and the absorbed dose rate induced by the source are given. (auth)

Radiation Sources

Refer also to abstracts 29530, 29765, 31070, 31251, and 31632.

29640 (BNWL-1744) LIST OF AEC RADIOISOTOPE CUSTOMERS WITH SUMMARY OF RADIOISOTOPE SHIPMENTS, FY 1972. Simmons, J. L. (Comp.). (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1973. Contract AT(45-1)-1830. 37p. Dep. NTIS $4.00.

This ninth edition of the AEC radioisotope customer list has been prepared, as previously, at the request of the Commission's Division of Applied Technology (formerly the Division of Isotope Development). It is a compilation of radioisotope sales during FY 1972 by Commission facilities at Argonne National Laboratory, Atlantic Richfield Hanford Company, Battelle-Pacific Northwest Laboratory, Brookhaven National Laboratory, United Nuclear Inc., Idaho Nuclear Corporation, Hanford Engineering Development Laboratory, Mound Laboratory, Oak Ridge National Laboratory, Richland Operations Office, and Savannah River Plant. The information is divided into four sections. The first is an alphabetical list of domestic and foreign customers. Included are the isotopes purchased by each customer and the laboratory supplying each isotope. The second section is an alphabetical list of isotopes, cross-referenced to customer numbers and again divided into the domestic and foreign categories. The third section is an alphabetical list of states and countries, also cross-referenced to customer numbers, indicating geographical concentrations of isotope users. The final section is a comprehensive table providing an alphabetical listing of the isotopes and a breakdown of shipments, quantities, and dollars for each isotope under the domestic,

foreign, and project (AEC facilities) categories as well as the total figures for each isotope. (auth)

29641 POWERFUL NEUTRON SOURCE BASED ON A Z PINCH. Gribkov, V. A.; Krokhin, O. N.; Sklizkov, G. V.; Filippov, N. V.; Filippova, T. I. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 9, 319-321(5 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 9, 541-544(5 Nov 1973).

The presently existing z-pinch modifications are compared. A proposed model whereby the thermal fraction of the neutron yield is produced (heating by an electron beam) is used to explain the increase of the neutron yield and of its thermal fraction with decreasing length of collective deceleration of the beam in the z-pinch. An experimental setup is proposed for increasing the neutron yield, based on a deuterated target at the chamber anode, preheated with a powerful laser prior to development of the relativistic electron beam in the z-pinch. (auth)

29642 RADIONUCLIDE EMITTERS FOR POSITRON-ANNIHILATION STUDIES OF CONDENSED MATTER. Campbell, J. L.; Jackman, T. E.; MacKenzie, I. K.; Schulte, C. W.; White, C. G. (Univ. of Guelph, Ont.). Nucl. Instrum. Methods; 116: No. 2, 369-380(1974).

The radioactive source aspect of positron-annihilation work is reviewed and evidence that the more commonly used radionuclides may give rise to systematic errors is summarized. Measurements both of positron lifetime and annihilation gamma-ray energy spectra with a variety of radionuclide emitters are reported. The results demonstrate quantitatively the superiority of the high-energy emitters $^{68}Ge/^{68}Ga$ and $^{44}Ti/^{44}Sc$ over the other available sources. Source backings are discussed, with future high-temperature work in mind. The generation of positron emitters within specimens by nuclear reactions is investigated and limitations on this approach are demonstrated. (auth)

29643 CALCULATION OF THE ACTIVATION RATE OF A CYLINDRICAL SAMPLE IRRADIATED BY A CYLINDRICAL FAST NEUTRON SOURCE. Gotoh, H. (Japan Atomic Energy Research Inst., Ibaraki); Yagi, H.; Kobayashi, K.; Kimura, I. Nucl. Instrum. Methods; 116: No. 2, 361-364(1974).

A calculation formula for the activation rate of a disc sample irradiated by a disc-shaped fast neutron source of isotropic emission is given in a form of elementary functions of geometrical parameters in the experimental arrangement. The activation rate of a cylindrical sample irradiated by a cylindrical source is expressed in a single integral form. Several numerical examples are also presented. (auth)

29644 A 2-DIMENSIONAL GAMMA HEAT SOURCE DISTRIBUTION CODE. Tanaka, Y. (Kawasaki Heavy Industries, Ltd., Kobe, Japan). FAPIG (Tokyo); No. 66, 86-89(Aug 1972). (In Japanese).

A 2-dimensional (R-Z) γ heat source distribution code, GAMHS, was developed for a CDC-6600 computer to be applied to the design calculations of γ-heat distribution and surface dose distribution in reactor pressure vessels, in-vessel components, in-pile loops, spent fuel transportation casks, and other facilities for γ-irradiation. The calculation is based on the ray analysis method taking buildup factors into account. The capacity of the code is as follows: number of energy groups ≤ 25, number of material regions $\leq 10 \times 10$, number of Chebyshev mesh $\leq 5 \times 5$, number of Gaussian integral mesh $\leq 15 \times 15 \times 15$, number of regions for γ-sources $\leq 3 \times 3$. Computation time is about 10 seconds for 1 group, 1 material region, 1 source region, 5×5 Chebyshev mesh points and $8 \times 8 \times 8$ Gaussian mesh points. The calculational model used and a flow chart for the code are described briefly. As an example, analysis of the γ-heat distribution in various parts of an in-pile gas loop to be installed in JMTR (Japan Material Testing Reactor) is presented. (JH)

Design and Fabrication

Refer also to abstract 29190.

29645 ROTARY SUPPORT FOR RADIATION TREATMENT APPARATUS. Offermann, B. P.; Barthel, R. (to Licentia Patent-Verwaltungs GmbH). US Patent 3,796,878. 12 Mar 1974. Priority date 5 Nov 1970, F.R. Germany. 6p.

A neutron radiation treatment apparatus having a high voltage generator, a neutron generator, and a collimator is described. The neutron generator is supplied with power from the high voltage generator. The collimator forms a beam of useful rays suitable for radiation treatment. The high voltage generator, the neutron generator and the collimator are rigidly connected together and are fastened to a rotatably mounted support plate. The high voltage generator and the neutron generator are disposed on one side of the support plate. The collimator is disposed on the other side of the support plate. (Official Gazette)

29646 METHOD AND APPARATUS FOR DIRECTING A RADIATION BEAM TOWARD A TUMOR OR THE LIKE. Scott, W. P. US Patent 3,794,840. 26 Feb 1974. Filed date 27 Mar 1972. 6p.

A method and apparatus are described for accurately directing a therapeutic radiation beam to a tumor or the like within a human body, including the implantation at the tumor of a source emitting radioactive rays traveling in a straight line therefrom, sensing this ray emission to determine a straight line path to the tumor, and directing the radiation beam toward the tumor by having the center line of the radiation beam coincide with the straight line path determined from the ray emitting source. Preferably, a radioactive isotope is implanted in the tumor as the source, and a collimating tubular channel member is selectively mounted on the radiation head of a radiation teletherapy machine with the axis of the channel member coinciding with the center of the beam from the radiation head. One end of the channel member is open to receive rays emitted from the implanted source and the other end is associated with a device for detecting these rays. The detecting device produces an electrical signal in response to the rays sensed, this electrical signal being greater as the straight line path of emitted rays comes into coincidence with the axis of the opening in the channel member, and the magnitude of the electrical signal is visually displayed. The teletherapy machine operator manipulates either the patient or the radiation head until the displayed signal indicates a maximum magnitude, removes the channel member and energizes the radiation head. (Official Gazette)

Industrial Uses

Refer also to abstracts 29047, 29048, 29113, 29125, 29248, 29678, 29685, and 30222.

29647 (AD-770107) AFRRI COBALT WHOLE-BODY IRRADIATOR. Carter, R. E.; Verrelli, D. M. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Mar 1973. 15p. (AFRRI-TN-73-3). NTIS $2.75.

The AFRRI cobalt irradiator contains two sets of sources, allowing for either unilateral or simultaneous bilateral irradiation of large animals or objects. With a loading of 25 kCi of ^{60}Co, exposure rates up to 400 R/minute are possible. The exposure rate can be varied either by changing the number of source rods or by changing the source to target distance. A brief description of the facility and the results of its calibration are presented. (auth)

29648 (EURISOTOP-83) TECHNOLOGY OF THE RADIO-INHIBITION OF THE GERMINATION OF POTATOES. Report on the Semi-Industrial Scale Tests, 1970-71 and 1971-72 Seasons. Sandret, F. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). 1973. 106p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Semi-industrial experiments on the radiopreservation of potatoes were conducted in Germany, Belgium, France, Italy, and the Netherlands. General conditions of the experiments, such as variety of potatoes, treatment for sprout inhibition, and storage time are discussed. Determinations were made on weight loss and per cent of usable tubers. Culinary evaluations were made and changes in chemical composition during storage were noted. Evaluations were made of the quality of potato chips and other finished potato products. Legal aspects of potato irradiation are discussed. (HLW)

29649 (INIS-mf-911, pp 30-33) DETECTION OF PLASTIC MINES BY GAMMA RAY BACKSCATTERING. Preiss, K.; Livnat, R. (Negev Inst. for Arid Zone Research, Beersheba, Israel). 1973.

From Transactions of the Israel Nuclear Society. Vol. 1; Yavne, Israel (26 Jun 1973).

An investigation was undertaken to develop a prototype to detect plastic mines by gamma ray backscattering. The prototype was required to operate with high reliability, at reasonably fast scanning speed, be as light weight as possible, and not present any health hazards. (INIS)

29650 (STI/PUB-369) SAFE USE OF RADIOACTIVE TRACERS IN INDUSTRIAL PROCESSES. Safety Series No. 40. (International Atomic Energy Agency, Vienna (Austria)). Jan 1974. 53p. IAEA $2.50.

The safe use of radioactive tracers in industrial processes is discussed under the following headings: basic radiation safety considerations; determination of radiation dose; role of competent authority; planning and design; and operational procedures. An introductory section discusses the objectives and scope of the guide and the basis of recommendations. (ERB)

29651 FABRICATION OF EXPLOSIVE COMPOSITIONS WITH MACROMOLECULAR BINDERS: EXPLOSIVE COMPOSITIONS OBTAINED IN THIS WAY. Balestic, F.; Bex, G.; Chadeyron, P. (to Commissariat a l'Energie Atomique). French Patent 2,138,513. 27 May 1971. 8p. (In French).

A process for the fabrication of explosives with macromolecular binders is described. In this process, an explosive substance is mixed with a polymer. The composition obtained is exposed to ionizing radiation and a vulcanization and/or the grafting of a monomer onto the polymer is then performed. (FR)

29652 INVESTIGATION OF RADIUM USE IN AIRCRAFT INSTRUMENT DIAL COMPANIES. Rogers, J. C.; Karbus, J. E. (Los Angeles County Health Dept.). pp 1837-1848 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

A survey of thirty-four aircraft instrument repair facilities in Los Angeles County was made to determine the degree of radiation hazard associated with their use and/or handling of radium instruments and dials. Facilities were visited by health physicists and the survey revealed a wide range of findings relative to the use and handling of aircraft instruments containing radium. Investigation included findings in relation to number of personnel, quantity and type of radioactive instruments on the premise, external radiation levels in work areas, amount of removable alpha contamination and the nature of activity associated with radium dials. None of the facilities had developed a program for the purpose of radiation safety, while some were unaware that they had radioactive material on instruments on the premises. It was concluded that seven of the thirty-four facilities surveyed had sufficient radioactive material on the premises and used in such a manner to require obtaining a California Radioactive Material License. (auth)

29653 RADIOACTIVE TRACER STUDIES IN THE HUNGARIAN CHEMICAL INDUSTRY. Balla, B. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Magy. Kem. Lapja; 28: No. 2, 73-82(1973). (In Hungarian).

A survey of the use of radioactive tracer techniques for on-site industrial investigation is presented. The main results of tracer studies carried out in the Hungarian chemical industry over the past ten years are given. (auth)

29654 PAINTING UNDER IONIZING RADIATIONS. Catier, E. Trait. Surface; No. 126, 11-15(Nov 1973). (In French).

Industrial developments in the field of radiation hardening of paints and varnishes in the USA, Europe, and Japan are presented. The advantages and disadvantages of the technique are discussed. (FR)

29655 APPLICATIONS OF RADIATION PROCESSING ENVISAGED DURING THE COMING 10 YEARS. Laizier, J. (CEN de Saclay, Gif-sur-Yvette, France). Develop. Ind. Sci.; No. 14, 10-13(Mar 1973). (In French).

Developments in radiation processing leading to simplified and less costly methods of producing γ ray sources together with the increased reliability and lower price of electron accelerators allow numerous industrial applications to be envisaged such as manufacture, development, and improvements of polymers for reinforced materials, adhesives, membranes, paints and varnishes, woods, textiles, coatings, papers, natural and artificial leathers, and construction plastics. (FR)

LIFE SCIENCES

29656 (ORNL-4412) BIOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1968. (Oak Ridge National Lab., Tenn. (USA)). Jul 1969. Contract W-7405-eng-26. 293p. Dep. NTIS $17.75.

Brief summaries are presented of research in progress in the fields of radiobiology, genetics, hematology, immunology, physiology, biochemistry, bacteriology, enzymology, microbiology, photosynthesis, biophysics, radiation protection, and related fields. A list is included of 212 publications in the world literature that report results of completed studies. (CH)

29657 (ORNL-4535) BIOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1969. (Oak Ridge National Lab., Tenn. (USA)). Jun 1970. Contract W-7405-eng-26. 196p. Dep. NTIS $13.00.

Brief summaries are presented of research in progress in the fields of radiobiology, genetics, hematology, immunology, physiology, biochemistry, bacteriology, enzymology, microbiology, photosynthesis, biophysics, radiation protection, and related fields. A list is included of 240 publications in the world literature that report results of completed studies. (CH)

29658 BASIS FOR RADIATION BIOLOGY. Devik, F. (Statens Institutt for Straalenhygiene, Oslo). pp 262-271 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

Following a historical introduction, the basic units are defined and the types of radiation sources and doses briefly described. The structure of cells is then explained and the chemical structure of organisms and the functions of DNA and RNA presented. (NO)

Radiation Effects on Biochemicals

Refer also to abstracts 29075, 29103, 29667, 29676, 29703, and 29825.

29659 (SGAE-2190) INTERNATIONAL SYMPOSIUM ON DNA-REPAIR AND LATE EFFECTS, VIENNA, DECEMBER 6-7, 1973. Abstracts. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). Nov 1973. 49p. (In English and German). (CONF-731215-(Absts.)). Dep. NTIS (U. S. Sales Only) $4.50.

From international symposium on DNA-repair and late effects; Vienna, Austria (6 Dec 1973).

29660 UV-INDUCED BREAKS IN INFECTIOUS DNA ISOLATED FROM T1-COLIPHAGES. Hotz, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp 251-255 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

After inactivation of infectious DNA from coliphage T1 with uv-light no double- and a negligible number of single-strand breaks are observed by the technique of sucrose gradient centrifugation. However, single-strand breaks of the DNA at a yield of about 1 break per lethal hit are produced after incorporation of 5-bromouracil. In BU-DNA the relation of uv-induced double- to single-strand breaks amounts to $1/_{17}$. The question of the relevance of BU-dependent DNA-breaks to the sensitization of phage is discussed. (auth)

29661 EFFECT OF NEUTRON RADIATION ON DENATURATION OF TISSUE DNA PREPARATIONS FROM ANIMALS OF DIFFERENT AGES. Khilobok, I. Yu.; Chebotarev, E. E.; Yatsenko, A. I. pp 14-19 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

The radiation sensitivity of DNA preparations made from the mucosa of the small intestine and liver of rats of different ages (1, 24, and 30 months) was studied. The preparations were irradiated with 10 krads of fast neutrons, and the molecular weight and melting point of the irradiated samples were determined. It was established that the radiation resistance of DNA depends on the degree of mitotic activity of the tissue and the age of the animal. For liver DNA the decrease in melting point with irradiation was not related to age, but the sensitivity of DNA preparations of the small-intestine mucosa did depend on age. The most sensitive DNA preparation was that from the small-intestine mucosa of old animals. (tr-auth)

29662 POSSIBLE MECHANISMS FOR RADIATION DISTURBANCE OF TRANSCRIPTION. Umansky, S. R.; Korol, B. A.; Runova, Y. N.; Tokarskaya, V. I. (Inst. of Biophysics, Pushchino, USSR). Int. J. Radiat. Biol.; 25: No. 1, 31-41(Jan 1974).

A method for quantitative analysis of histone-DNA interaction in polyacrylamide gel was developed. It was shown that γ-irradiated DNA binds a smaller amount of all histone fractions than does native DNA, but more than is found in chromatin isolated from the cells of higher organisms. Thus, it is deduced that dissociation of histone from chromatin is probably not a primary radiation effect. The solubility of complexes of total histones and of histone fraction F_1, F_{2a}, F_{2b}, F_3 with irradiated DNA was found to be greater than that of histone-native-DNA complexes; also, the complex with irradiated DNA becomes more soluble in the presence of excess histones. Histones produce a weaker inhibitory effect on the template activity of irradiated DNA than of native DNA for RNA polymerase. The template activity of chromatin rises after small doses of γ radiation (up to 5 krads) and then falls at higher doses. On the basis of these data, a theory for the effects of radiation on the transcription process is proposed. (auth)

29663 DISULPHIDE PROTEINS IN THE BINDING REACTION WITH RADIOPROTECTOR MEG. Horvath, M.; Csagoly, E. (Inst. of Nuclear Physics, Budapest). Int. J. Radiat. Biol.; 25: No. 1, 87-94(Jan 1974).

At physiological pH, disulphide bonds of native proteins did not react with the radioprotector AET in its -SH form of MEG. At alkaline pH and under the effect of molecular unfolding agents such as urea, SS-bonds in proteins were labilized and apt to bind the radioprotector. Insulin-MEG mixed disulphide complexes resisted separation into A and B chains on performic-acid oxidation and biological tests proved that they were not reactivated by mercaptoethanol and following reoxidation. ^{60}Co γ irradiation stabilized the mixed disulphide bond with the radioprotector. It could not be further reduced by thiols. Radiation-induced denaturation with bovine albumin was slightly inhibited. The behavior of insulin was less affected by the presence of the radioprotector on the molecule. (auth)

29664 RADIATION DAMAGE TO PROTEINS. Effect of Ultraviolet Illumination on the Secondary Radical Reactions in a Single Crystal of Glycyl-Glycine. Meloe, T. B. (Univ. of Oslo). Int. J. Radiat. Biol.; 25: No. 2, 161-166(Feb 1974).

Single crystals of glycyl-glycine were electron-irradiated and then exposed to ultraviolet illumination at 77°K before being brought up to room temperature. Compared with heating of the crystals alone, different radicals were formed from the primary stabilized radicals after the electron irradiation. (auth)

29665 RADIATION-INDUCED CHANGES IN ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF NITRIC OXIDE HEMOGLOBIN. Gasyna, Z.; Bachman, S. (Technical Univ., Lodz, Poland). Stud. Biophys.; 39: No. 3, 231-236(1973).

The electron paramagnetic resonance method was used to study nitric oxide hemoglobin as a probe system for the investigation of radiation-induced changes in oxy- and methemoglobin. The gamma radiation absorbed in the hemoprotein solution brought about a characteristic hyperfine structure in the EPR spectra of the NO derivatives, the intensity being dependent on the dose and on which of two hemoproteins was used. The concomitant appearance of the hemochromogen species was followed by the visible absorption measurements. (auth)

29666 ESR STUDY OF THE NATURE AND PROPERTIES OF PARAMAGNETIC CENTERS IN γ-IRRADIATED PROTEINS: SULPHUR-CONTAINING RADICALS. Kayushin, L. P.; Krivenko, V. G.; Pulatova, M.; Sud'bina, E. (Inst. of Biological Physics, Puscino, USSR). Stud. Biophys.; 39: No. 3, 193-206(1973).

From the data of ESR study it is evident that when proteins are γ-irradiated at 77°K, in vacuum, the formation of anion-radicals of disulphide bonds of protein molecules is observed. These anion-radicals R-S-S$^-$-R disappeared under light effect 320 to 450 nm. This conclusion was made on the basis of the study of: (a) ESR spectra of single crystals of sulphur-containing amino-acids; (b) electron structure of radicals R-S-S$^+$-R, R-S$^+$-H, and RS$^\cdot$ by a molecular orbital calculation of extended Hückel theory; (c) calculation of theoretical line shape for a polycrystalline sample containing a radical with three different g-values for R-S-S$^-$-H, RSS$^\cdot$, RS$^\cdot$, RS$^-$H, RS$^+$H. The radicals like RS$^\cdot$ and RSS$^\cdot$ were observed in γ-irradiated proteins at room temperature. (auth)

Radiation Effects on Cells

Refer also to abstracts 29695, 29804, and 29825.

29667 (SGAE-2211) ACTION OF 2,4,5-TE ON DNA-REPAIR AFTER UV- OR IONIZING RADIATION. Antoni, F.; Vincze, I.; Klein, W.; Kocsis, F. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Dec 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

The effect of 2,4,5-trichlorophenoxyethanol (2,4,5-TE) was studied on the excision-repair system in mouse spleen cells. The incorporation rate of marked thymidine in the DNA of the cells treated with 10^{-4} M 2,4,5-TE was lower in both cases after irradiation with uv light or gamma rays. The sedimentation of DNA in alkaline sucrose-gradient after gamma-irradiation showed that 5×10^{-5} M 2,4,5-TE inhibited the rejoining of DNA single strand breaks. (auth)

29668 (SGAE-2218) EFFECT OF 2,4-D ON SEMICONSERVATIVE- AND DNA-REPAIR SYNTHESIS (CASE REPORT: BULLOUS DERMATITIS AFTER EXPOSURE TO 2,4-D). Balo-Banga,, M. J.; Antoni, F.; Altmann, H.; Vincze, I.; Kocsis, F. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Dec 1973. 9p. Dep. NTIS (U. S. Sales Only) $4.00.

One case of accidental exposure to 2,4-D, presumably in very low doses, caused bullous skin lesions. In addition 2,4-D was tested in a mammalian cell system in respect to an inhibition of semiconservative DNA synthesis and DNA repair. For DNA repair cells were irradiated with gamma rays or uv light respectively. Incubation with 10^{-4} M or 5×10^{-4} M 2,4-D caused an inhibition of both synthesis. (auth)

29669 HISTONE F1 PHOSPHORUS CONTENT AND DNA SYNTHESIS IN SLOWLY-GROWING SUBLINES OF L5178Y-S CELLS. Szumiel, I.; Rosiek, O.; Beer, J.; Budzicka, E.; Sablinski, J.; Kopec, M. (Inst. of Nuclear Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 21: 7-12(1973).

Slowly-growing sublines were isolated by cloning from x-irradiated cell populations of L5178Y-S cells. Phosphorus content of histone F1 and ^{3}H-thymidine incorporation into DNA were determined for 7 such sublines with various mean doubling times. It was found that both histone F1 phosphorylation and the ability to incorporate ^{3}H-thymidine into DNA are impaired in these sublines and that degree of the impairment correlates with the proliferation rate. (auth)

29670 COMBINED CYTOLYTIC EFFECT OF X IRRADIATION AND CELL-MEDIATED IMMUNE REACTIONS ON TUMOR CELLS IN VITRO. Song, C. W.; Levitt, S. H. (Univ. of Minnesota, Minneapolis). Radiology; 111: No. 1, 213-214(Apr 1974).

In order to assess the possibility of combining radiotherapy and immunotherapy, the effect of x irradiation on in vitro reaction between immune lymphocytes and target tumor cells was studied. Damage to tumor cells was quantitated via release of ^{51}Cr from ^{51}Cr-labelled target tumor cells. Splenic lymphocytes of C57BL mice injected with mastocytoma cells of DBA/2J mice were cytotoxic against mastocytoma cells in vitro. Damage to tumor cells was increased significantly on irradiating them with 2,000 rads prior to interaction with immune lymphocytes. (auth)

29671 ENERGY-DEPENDENCE OF CELLULAR RECOVERY FROM SUBLETHAL RADIATION INJURY: ITS POSSIBLE IMPORTANCE IN FRACTIONATED RADIOTHERAPY. Revesz, L.; Littbrand, B. (Kungliga Karolinska Mediko-Kirurgiska Institutet, Stockholm). pp 155-159 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

The energy-dependence of recovery from sublethal radiation injury was studied by exposure of Chinese hamster cells in different growth phases to x-radiation in varying grades of hypoxia. The extent of recovery was found to be similar to the extent of cellular respiration at different oxygen concentrations. Due to a different relationship existing between the enhancement of radiosensitivity and concentration of oxygen, recovery was shown to compensate for the increase of sensitivity when relatively small radiation doses were given; after large doses, the compensation was gradually reduced. Based upon this dependence of the net oxygen effect on radiation dose it was suggested that small dose fractions may be effective in the radiation therapy of hypoxic tumors, and large dose fractions in the therapy of largely oxic tumors. (INIS)

29672 EFFECTS OF CAFFEINE ON RADIATION-INDUCED PHENOMENA ASSOCIATED WITH CELL-CYCLE TRAVERSE OF MAMMALIAN CELLS. Walters, R. A.; Gurley, L. R.; Tobby, R. A. (Los Alamos Scientific Lab., NM). Biophys. J.; 14: No. 2, 99-118(Feb 1974).

Caffeine induced a state of G_1 arrest when added to an exponentially growing culture of Chinese hamster cells (line CHO). In addition to its effect on cell-cycle traverse, caffeine ameliorated a number of the responses of cells to ionizing radiation. The duration of the division delay period following x-irradiation of caffeine-treated cells was reduced, and the magnitude of reduction was dependent on caffeine concentration. Cells irradiated during the DNA synthetic phase in the presence of caffeine were delayed less in their exit from S, measured autoradiographically, and the radiation-induced reduction of radioactive thymidine incorporation into DNA was lessened. Cells synchronized by isoleucine deprivation, while being generally less sensitive to the effects of ionizing radiation than mitotically synchronized cells, were equally responsive to the effects of caffeine. The x-ray-induced reduction of phosphorylation of lysine-rich histone F1 was less in caffeine-treated cells than in untreated cells. Finally, survival after irradiation was only slightly reduced in caffeine-treated cells. A possible role of cyclic AMP in cell-cycle traverse of irradiated cells is discussed. (auth)

29673 EFFECT OF IMMUNOLOGICAL INHIBITION OF LYSOSOME FUNCTION ON RADIATION SURVIVAL OF RAT SARCOMA CELLS IN CULTURE. Paris, J. E.; Wang, L. (Boston Univ.). Int. J. Radiat. Biol.; 25: No. 1, 95-98(Jan 1974).

An antibody capable of inhibiting lysosomal hydrolytic activity was prepared and its effects on the γ-radiation survival curves of cultured CCL 47 rat-sarcomal cells were studied over a dose range 0 to 800 rads. In 22 experiments, an average D_0 of 160 rads was determined. The average extrapolation number was 1.7. In 17 experiments in the presence of antilysosomal globulins, an average of D_0 of 200 rads and an extrapolation number of 1.4 were found. It is postulated that these enhanced survival rates were due to the immunological suppression of the lysosomal hydrolytic activity. Participation of endogenous acid hydrolases in cell autolysis would be impaired by their insolubilization in situ by the antilysosomal antibodies. A delay in the autolytic events would provide a certain advantage to partially injured cells that retained repair capabilities. (UK)

29674 INFLUENCE OF CERTAIN TECHNICAL PARAMETERS ON THE SHAPE OF DOSE-RESPONSE CURVES IN STUDIES OF X-RAY INACTIVATION OF HUMAN CELLS CULTIVATED IN VITRO. Pettersen, E. O.; Oftebro, R.; Brustad, T. (Norsk Hydro, Oslo). Int. J. Radiat. Biol.; 25: No. 1, 99-103(Jan 1974).

Survival curves are presented for a human cell line MHIK 3025 x-irradiated over a range 0 to 1000 rads with 220 kV x rays in suspension, or when attached to glass or plastic Petri dishes. No significant difference appeared to exist between the curves based on experiments in which cells were irradiated in suspension or attached to glass. The dose-response curve for cells irradiated when attached to plastic dishes showed a negative curvature within the whole range studied. For doses higher than 500 rads, the survival fraction was significantly lower than that for cells irradiated in suspension or attached to glass. (UK)

29675 EFFECT OF IRRADIATION ON LYSOSOMAL ACTIVATION IN HeLa CELLS. Reynolds, C.; Wills, E. D. (Saint Bartholomew's Hospital, London). Int. J. Radiat. Biol.; 25: No. 2, 113-120(Feb 1974).

The effect of irradiation on the lysosomes of HeLa cells was studied using a new quantitative histochemical method. Up to 5 hrs after γ irradiation with 5 krads, no activation of the lysosomal enzymes was measured and it was concluded that no immediate damage to the lysosomes had occurred. Twenty-four hours after irradiation with doses of 300 to 1000 rads, lysosomal activation was observed under the light microscope and measured quantitatively; there were increases in lysosomal activity not apparent by observation of gross morphology, and lysosomal enzyme activity increased progressively with dose. It is considered that lysosomal activation is an important consequence of irradiation that contributes to cell damage and death. (auth)

29676 COMPARISON OF THE EFFECTS OF X IRRADIATION AND SULPHYDRYL BLOCKING AGENTS ON THE POTASSIUM ION CONTENT OF THYMOCYTES IN VITRO. Chapman, I. V.; Sturrock, M. G. (Dundee Univ., Scotland). Int. J. Radiat. Biol.; 25: No. 2, 151-160(Feb 1974).

The change in intracellular potassium content of rat thymocytes in vitro was investigated after exposure to x rays 1 to 20 krads, x rays plus N-ethyl maleimide (NEM) 0.01 to 0.08 mM, and NEM 0.01 to 0.10 nM. The chemically induced leakage of potassium ions produced by NEM and the synergistic action of NEM plus x rays were both found to be related to the decrease in available sulphydryl groups of the cell. However, the leakage of potassium

produced by x rays alone was only partially related to –SH group content. The radiosensitizing action of NEM on potassium decrease in the cell appeared to result from an increased passive efflux as NEM was found to have no influence on the radiation induced depression of active transport. It is suggested that the variation in enhancement ratio reported for NEM action over dose range 1 to 20 krads supports the concept of a two mechanism action of radiation on cell potassium concentration. (auth)

29677 SINGLE-STRAND INTERRUPTIONS IN NEWLY SYNTHESIZED DNA IN CHINESE HAMSTER CELLS AFTER X IRRADIATION. Koerner, I.; Malz, W. (Zentralinstitut fuer Molekularbiologie, Dresden). Stud. Biophys.; 41: No. 1, 11-20 (1973).

DNA synthesized in cells of Chinese hamster V79/4 after x irradiation has segments of lower molecular weight than non-irradiated cells, as shown by pulse-labeling with tritiated thymidine, followed by sedimentation of the DNA in alkaline sucrose gradients. Postincubation of the x-irradiated cells increases the single-strand molecular weight of the newly synthesized DNA to the control level. With the same technique this was also shown by us after uv irradiation of Chinese hamster cells as it was earlier determined by others for mouse L 5178 Y cells, human cells, and also Chinese hamster cells. Possibilities are discussed to explain the decrease of single-strand molecular weight after x irradiation with 500 rad. (auth)

Radiation Effects on Microorganisms

Refer also to abstract 29806.

29678 (CEA-CONF-2480) INFLUENCE OF GAMMA IRRADIATION ON THE HEALTHFULNESS AND TECHNOLOGICAL PROPERTIES OF CORN STARCH. Saint-Lebe, L.; Berger, G.; Mucchielli, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France)). 1973. 12p. (In French). (CONF-730684-1). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting of the study group on the improvement of the quality of foods by irradiation; Vienna, Austria (18 Jun 1973).

In most cases the γ irradiation of corn starch at a dose of 300 krad provides for the desired sterilization without modifying the organoleptic properties of the product. Among the induced modifications, the formation of hydrogen peroxide can present a short-term interest for the technologist. (auth)

29679 (CONF-740303-1) ULTRAVIOLET-INACTIVATION OF CONIDIA FROM HETEROKARYONS OF NEUROSPORA CRASSA CONTAINING UV-SENSITIVE MUTATIONS. Shelby, M. D.; de Serres, F. J.; Stine, G. J. (Oak Ridge National Lab., Tenn. (USA)). 1973. 35p. Dep. NTIS $3.75.

From 7th neurospora information conference; Asilomar, California, USA (25 Mar 1974).

The effect of three uv-sensitive mutations of Neurospora crassa, upr-1, uvs-4 and uvs-6, on the ultraviolet-inactivation of conidia from two-component heterokaryons was investigated. In two-component heterokaryons with wild-type sensitivity to radiation inactivation, all three conidial fractions exhibited similar ultraviolet-inactivation curves. Each uv-sensitive mutation studied uniquely modified the ultraviolet-inactivation curves of conidia from two-component heterokaryons. In heterokaryons heterokaryotic for upr-1, the upr-1 mutation was recessive and the repair function determined by the wild-type allele was functional to some degree in homokaryotic upr-1 conidia. All three conidial fractions of heterokaryons containing upr-1 in both components showed increased sensitivity to ultraviolet light. The uvs-4 mutation was recessive and resulted in conidia with increased uv-sensitivity only when included in both components of a heterokaryon. Homokaryotic uvs-4 conidia, which arose from heterokaryons containing both uvs-4 and wild-type components, exhibited wild-type survival. Therefore, as with upr-1, there was a carryover of the repair capability to conidia which were genetically uv-sensitive. The uvs-6 mutation, when included in one component of a two-component heterokaryon, resulted in increased uv-sensitivity of both heterokaryotic and homokaryotic uvs-6 conidia. When both components contained uvs-6, the uv-sensitivity of all three conidial fractions was increased and all showed similar inactivation curves. Thus, as with upr-1 and uvs-4, there was a carryover of the wild-type repair capability to genetically uvs-6 conidia. Heterokaryon tests for complementation between two non-allelic uv-sensitive mutations showed that in heterokaryotic conidia, complete complementation occurred between upr-1 and uvs-4. (auth)

29680 (RISO-260) COMPARISON OF THE BIOLOGICAL EFFECTS IN RATS OF RADIATION STERILIZED AND AUTOCLAVE STERILIZED FOOD. Eriksen, W. H.; Hjarde, W.; Lieck, H.; Juul, A.; Emborg, C. (Danish Atomic Energy Commission, Risoe, Research Establishment). Jun 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Three Groups of SPF Wistar rats were fed on radiation-sterilized, autoclave-sterilized, and ordinarily autoclave-treated SPF food respectively. During 1½ years' experimentation no significant differences between the groups were found with regard to general health, growth rate, feed consumption, and reproduction performance. Mutagenic effects were not demonstrated either at autopsies or at a dominant lethal mutation test. (auth)

29681 (TID-26548) ALTERATIONS INDUCED BY X RAYS AND ULTRAVIOLET LIGHT ON THE SYNTHESIS AND MAINTENANCE OF MACROMOLECULAR COMPONENTS WITHIN CELLS. Progress Report, February 1, 1973–March 1, 1974. Billen, D. (Tennessee Univ., Knoxville (USA)). 1974. Contract AT(40-1)-4568. 7p. Dep. NTIS $3.00.

Progress is reported on the following research projects: regulation of DNA synthesis in Bacillus subtilis after x irradiation; repair synthesis and the role of DNA polymerase I in x-irradiated B. subtilis made permeable to nucleotides; role of DNA polymerase in uv repair; studies on uvr⁻ mutants; repair of transforming DNA in competent cells; and repair of transforming activity in radiosensitive mutants. (HLW)

29682 IMPORTANCE OF ENERGY METABOLISM IN POST-IRRADIATION CELLULAR PROCESSES. Kiefer, J. (Univ., Giessen, Ger.). pp 209-212 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

The sparing effect of dose fractionation with x rays and uv light was studied in diploid yeast, Saccharomyces cerevisiae. The sparing effect developed at the same rate and to the same extent in air or under hypoxia if the cells were held in glucose containing nutrient medium. With non-fermentable substrates the process was slower in air, and sparing absent in hypoxia. Experiments with metabolic inhibitors indicate that split-dose sparing may depend on ATP-production. Fermentation and respiration rates are also increased in irradiated cells. (auth)

29683 DIRECT ENZYMATIC REPAIR OF DEOXYRIBONUCLEIC ACID SINGLE-STRAND BREAKS IN DORMANT SPORES. Durban, E.; Grecz, N.; Farkas, J. (Illinois Inst. of Tech., Chicago). J. Bacteriol.; 118: No. 1, 129-138(Apr 1974).

With the alkaline sucrose gradient centrifugation method, it was found that dormant spores of Clostridium botulinum subjected to 300 krads of gamma radiation showed a distinct decrease in deoxyribonucleic acid (DNA) fragment size, indicating induction of single-strand breaks (SSB). A two- to threefold difference in radiation resistance of spores of two strains of C. botulinum, 33A (37% survival dose [D_{37}] = 110 krads) and 51B (D_{37} = 47 krads), was accompanied by relatively larger DNA fragments (molecular weight 7.9×10^7) obtained during extraction from the radiation-resistant strain 33A and smaller DNA fragments (molecular weight 1.8×10^7) obtained under identical conditions from radiation-sensitive strain 51B. The apparent number of DNA SSB produced by 300 krads in strains 33A and 51B was 0.37 and 3.50, respectively, per 10^9 daltons of DNA. Addition of 0.02 M ethylenediaminetetraacetic acid (EDTA) to spore suspensions during irradiation doubled the apparent number of SSB in strain 33A but had no effect on strain 51B. In vivo, 0.02 M EDTA present during irradiation to 100 to 300 krads decreased survival of spores of 33A by about 30% but had little or no effect on 51B. Survival of 33A was also reduced by about 45% when the spores were irradiated while frozen in dry ice (–75 C) and, after irradiation, immediately exposed to 0.03 M EDTA for 1 h to inhibit repair in the dormant spores. These results suggest that the highly radiation-resistant strain 33A may be able to accomplish repair of SSB during irradiation or after irradiation under nonphysiological conditions, i.e., in the dormant state. This repair can be inhibited by EDTA. Sedimentation patterns show that DNA from spores of both strains 33A and 51B did not show any postirradiation repair during the first 6 h of germination, as opposed to Bacillus subtilis spores, which exhibit repair immediately after germination. These observations suggest the existence of direct repair in physiological dormant spores of strain 33A in the cryptobiotic resting state in the absence of germination. The repair seems to be similar to that of polynucleotide ligase activity shown to be operative in some vegetative cells. Apparently radiation-sensitive strains such as 51B and B. subtilis are generally poor in DNA repair enzyme activity under conditions of spore dormancy, which may account for the approximately threefold difference in radiation sensitivity or DNA fragility of different strains, or both. (auth)

29684 USE OF ULTRAVIOLET RADIATION TO LOCATE DIPICOLINIC ACID IN BACILLUS CEREUS SPORES. Germaine, G. R.; Murrell, W. G. (Commonwealth Scientific and Industrial Research Organization, North Ryde, Australia). J. Bacteriol.; 118: No. 1, 202-208(Apr 1974).

A novel method is described that allows a direct determination of the location of a portion of the dipicolinic acid (DPA) in spores. Ultraviolet (uv) irradiation is shown to cause cross-linkage of DPA to spore proteins which have the characteristics of membrane proteins. We suggest that DPA resides in the inner forespore membrane (IFSM) and spore cytoplasm (i.e., the spore protoplast). Only that portion of the DPA in the vicinity of the IFSM appeared to form uv-induced DPA-protein adducts. (auth)

29685 TISSUE REACTION OF PARENCHYMATOUS ORGANS FOLLOWING IMPLANTATION OF CONVENTIONALLY AND RADIATION STERILIZED CATGUT. Helpap, B.; Staib, I.; Seib, U.; Osswald, J.; Hartung, H. (Univ., Bonn). Bruns Beitr. Klin. Chir.; 220: No. 3, 323-333(May 1973). (In German).

Following implantation into the muscles, liver, and kidneys of rats and rabbits of chromed and unchromed catgut sterilized by ethylene oxide and by gamma radiation, the cellular reactions were investigated using the usual histological techniques. The unchromed catgut was resorbed as rapidly in the parenchymatous organs as in the muscles. Resorption of chromed catgut was significantly delayed. Acute inflammatory reactions were more pronounced in the subcutaneous muscles than in the liver and kidneys. There was no essential difference between conventionally and radiosterilized catgut with regard to tissue reactions and resorption. (HLW)

29686 REPAIR OF DOUBLE STRAND BREAKS IN X-IRRADIATED MICROCOCCUS RADIOURANS. Dean, C. J.; Feldschreiber, P.; Burrell, A. D. (Inst. of Cancer Research, Sutton, Eng.). pp 197-201 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

Evidence is presented that the exceptionally radioresistant Micrococcus radiodurans is able to repair double strand breaks in DNA. The results indicate that the DNA molecule is attached to the plasma membrane at multiple sites. The bonds between DNA and membrane become stable towards the lytic procedure after x-ray irradiation and can thus be revealed. Multiple attachment of the chromosome to the membrane would provide the necessary supporting structure to prevent disorganization of the genome and permit correct sequential rejoining of the broken DNA molecules. (INIS)

29687 ANTI-RADIATION PROPERTIES OF DNA IN NEUTRON IRRADIATION. Chebotarev, E. E.; Ryabova, E. Z.; Indyk, V. M. pp 74-79 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

The antiradiation properties of heterologous, homologous, and isologous DNAs and of their heat denaturation and hydrolysis fermentation products were studied in fast-neutron-irradiated yeast cells. The DNA showed a protective action that did not depend on the degree of isologousness or polymerization of the compounds studied. Only when the DNA was decomposed into its nitrogen bases was the protective action completely destroyed. Possible mechanisms of the anti-radiation action of DNA are discussed. (tr-auth)

29688 QUANTITATIVE EVALUATION OF THE ANTI-RADIATION ACTION OF DNA IN FAST-NEUTRON-IRRADIATED YEAST CELLS. Ryabova, E. Z.; Indyk, V. M.; Sten'ko, A. S. pp 79-83 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

The antiradiation properties of isologous DNA separated from Saccharomyces vini, strain megri-139B were studied in fast-neutron-irradiated yeast cells. The increased dose factor was used for quantitative evaluation of the prophylactic and therapeutic action of DNA. The prophylactic use of DNA increased the viability of 8- to 14-krad irradiated microorganisms 26 to 36%, but the therapeutic use increased it only 16 to 19%. The therapeutic effect was established only for doses no greater than 12 krads (LD-55). The increased dose factor was 1.6 for the prophylactic action of DNA and 1.3 for the therapeutic action. (tr-auth)

29689 ACTION OF FAST NEUTRONS ON THE NODULE BACTERIA OF CLOVER AND PEA. Voitenko, L. M. Mikrobiol. Zh.; 34: No. 6, 697-700(1972). (In Russian).

When irradiating nodule bacteria of clover and pea by fast neutrons with doses of 1000, 2000, and 10,000 rad variants with the increased dehydrogenase activity were obtained. Inoculation of pea and clover seeds by these changed variants of strains of the nodule bacteria has a positive effect on virulence, crop yield, and also on the nitrogen-fixing activity. (auth)

29690 RADIATION SENSITIZATION OF BACTERIAL SPORES AND PHAGE T7 BY NaBr. Simic, M.; Powers, E. L.; Centilli, M.; Cross, M. (Univ. of Texas, Austin). Int. J. Radiat. Biol.; 25: No. 1, 43-50(Jan 1974).

Spores of Bacillus megaterium and the bacteriophage T7 were sensitized to x rays by NaBr in N_2 purged systems up to the O_2 level of sensitivity. This sensitivity is due to the action of $\cdot Br_2^-$ formed by reaction of $\cdot OH$ with Br^-. Many additives, representing biologically significant compounds or portions of their structure were tested for their effect on the NaBr-induced sensitization. Proposals are made from these results as to the mechanisms of sensitization by NaBr, as well as reactivities of various additives with $\cdot Br_2^-$. (auth)

29691 EFFECT OF POTASSIUM NITRATE ON PHOTOREACTIVATION OF ESCHERICHIA COLI CELLS. Balgavy, P. (Slovenska Akademia Vied, Bratislava). Z. Naturforsch.; 28c: No. 11-12, 757-760(Dec 1973).

The increase of survival of ultraviolet-irradiated Escherichia coli cells, due to the splitting of thymine dimers to monomers by photoreactivation, is inhibited by potassium nitrate. The possible mechanisms of the inhibition are discussed. (auth)

29692 NATURE OF THE NEW DNA SYNTHESIZED BY DNA-MEMBRANE COMPLEXES ISOLATED FROM IRRADIATED E. COLI. Cramp, W. A.; Walker, A. (Hammersmith Hospital, London). Int. J. Radiat. Biol.; 25: No. 2, 175-187(Feb 1974).

The size distribution of new DNA synthesized in vitro by DNA-membrane complexes isolated from E. coli B/r electron-irradiated under anoxic and aerobic conditions was determined by the use of alkaline-sucrose gradients. Although there was considerable depression in synthesis, especially after irradiation under aeration, there was no appreciable change in the distribution of sizes of DNA fragments. It is concluded that after irradiation the DNA-membrane complexes isolated from some bacteria synthesize DNA to an unaltered extent, whereas DNA-membrane complexes from other bacteria cease to make DNA at all. It is suggested that it is possible that energy deposited anywhere within the DNA-membrane structure in the intact bacterium is transferred to the initiation point for DNA synthesis. (auth)

29693 INACTIVATION OF BACTERIOPHAGE T7 BY SELECTIVE INORGANIC RADICALS. Redpath, J. L.; Dewey, D. L. (Mount Vernon Hospital, Northwood, Eng.). Int. J. Radiat. Biol.; 25: No. 2, 189-195(Feb 1974).

The inactivation of suspensions of γ-irradiated bacteriophage T7 in buffer, by the selective inorganic radicals Br_2^- and $(CNS)_2^-$, was investigated. The efficiency of inactivation by Br_2^- was shown to be 16 times greater than that due to $(CNS)_2^-$. The results showed that tyrosine and/or histidine residues are important to the biological function of the phage tail, whereas tryptophan and cysteine residues are not as essential. The effect of several amino acids on the inactivation by both Br_2^- and $(CNS)_2^-$ has been studied. The data demonstrate the specificity of reaction of these radicals with certain amino acids. (auth)

29694 CULTURE MEDIA. Freeman, A. E. (to Microbiological Associates Inc.). British Patent 1,339,522. 5 Dec 1973. Filed Date 9 Mar 1972. 7p.

A method is described for the preparation of a stable, sterilized, dry culture medium for the in vitro growth of animal cells. The culture medium in dry solid form is irradiated with beta or gamma radiation to doses of 0.8 to 10 MR. The culture medium may include heat unstable amino acids, such as L-glutamine, or vitamins such as pyridoxal hydrochloride; also coenzyme A and carmelizable glucose. (UK)

29695 RADIATION SENSITIVITY OF BACILLUS SUBTILIS IN DEPENDENCE ON RADIATION QUALITY. Kampf, G.; Abel, H. (Zentralinstitut fuer Molekularbiologie, Dresden). Stud. Biophys.; 41: No. 1, 1-10(1973). (In German).

Bacillus subtilis W 23 was irradiated in suspension by use of radiations of different ionizing density. Survivors were estimated by their colony-forming ability on agar plates. The radiation sensitivity $[(1/D37\ krad^{-1})]$ of B. subtilis expresses a characteristic dependence on the LET of radiation showing a maximum value at a LET of 16 keV/μm. From the course of this curve it is possible to evaluate the size of the target (0.2 μm), the length of the DNA macromolecule (maximum 1 mm), and the repair capacity of the bacterial cell by means of a model of action of ionizing radiations on DNA, microorganisms, and mammalian cells which was developed in our institution. Double-strand breaks account for inactivating events whereas single strand breaks are completely repaired. (auth)

29696 POSTIRRADIATION RECOVERY OF YEAST UNDER CONDITIONS OF NORMAL, SULPHITAL, AND ALKALINE FERMENTATION. Mosin, A. F.; Mironyuk, G. V. (Inst. of Medical Radiology, Obninsk, USSR). Stud. Biophys.; 41: No. 1, 41-50(1973). (In Russian).

The recovery of γ-irradiated diploid yeast incubated in anaerobic conditions in presence or absence of alkaline (pH 8.5) or HSO_3^- ions was studied. It was found that alkaline and sulphital fermentations are unfavorable for postirradiation recovery. The results of the present work and also earlier observation led to the conclusion that the Embden-Meyerhof cycle itself is not so important for recovery. On the other hand the pentose cycle seems to be very important for this process. (auth)

29697 EFFECT OF UV-LIGHT, CAFFEINE, AND NALIDIXIC ACID ON DIVISION ABILITY OF UV-SENSITIVE FILAMENT-FORMING MUTANTS OF SALMONELLA TYPHIMURIUM. Pokrovskii, V. N.; Guseva, O. A. (Inst. of Epidemiology and Microbiology, Moscow). Genetika; 10: No. 1, 123-129(1974). (In Russian).

The data presented have shown that the addition of caffeine to the plating medium used to assay postirradiation viability of uv-sensitive filament-forming mutants of Salmonella typhimurium resulted in decreased survival. Liquid holding recovery of the mutants is inhibited by caffeine. The uv-sensitive filament-forming mutants of S. typhimurium are very sensitive to nalidixic acid. Incubation in the medium containing nalidixic acid induced long filament formation in mutants. Microscopic observation of uv-irradiated mutant P20 cells indicated that filamentous cells resume cell division and possessed the colony-forming ability. The observed identity of the uv-survival curves of non-lysogenic and lysogenic cells is due to the fact, that uv-irradiated lysogenic cells divide before lysis, yielding both an infective center and a surviving colony. (auth)

29698 GENETIC STUDY OF RADIATION AND NITROUS ACID SENSITIVITY OF YEAST. Arman, I. P.; Devin, A. B.; Dutova, T. A. (Inst. of Atomic Energy, Moscow). Genetika; 10: No. 1, 112-118(1974). (In Russian).

The survival after the nitrous acid (NA) treatment of seven haploid strains of Saccharomyces cerevisiae was studied. Six of these strains carry mutations in different loci that enhance the radiosensitivity of yeast cells. All the x-ray-sensitive mutants (xrs_1, xrs_2, and xrs_4) are more NA-sensitive than the wild type haploid. Two radiosensitive mutants (uvs_3-rad_4 and xrs_1) and the strain with normal radiosensitivity were crossed and the diploid hybrids from these crosses were isolated. Analysis of the meiotic progeny of these hybrids shows that the high NA-sensitivity and high radiosensitivity may segregate. The data obtained lead to the conclusion that a few genetic factors determine the differences in NA-sensitivity of the segregational lines studied. These factors are able to eliminate or suppress the effect of uvs_3 and xrs_1 mutations on the NA-sensitivity if the mutations mentioned really have these effects. (auth)

29699 RESPIRATION, GROWTH, AND VIABILITY OF REPAIR-DEFICIENT MUTANTS OF ESCHERICHIA COLI AFTER ULTRAVIOLET IRRADIATION. Swenson, P. A.; Schenley, R. L. (Oak Ridge National Lab., TN). Int. J. Radiat. Biol.; 25: No. 1, 51-60(Jan 1974).

Escherichia coli WP2 (a tryptophan-requiring strain of B/r) and three mutants deficient in DNA repair processes were used for a comparative study of the effects of ultraviolet radiations on respiration. An hcr^- strain behaved similarly to WP2 hcr^+; respiration ceased about an hour after uv. The doses used for stopping respiration were 55 and 520 erg/mm² respectively; these doses reduced survival in each case to about 0.5% WP2 rec^- (Rec A) and WP2 exr^- strains did not cease respiring after receiving a range of doses up to 520 ergs/mm². Following irradiation, WP2 hcr^+ and WP2 hcr^- cells degraded their DNA slightly if at all, but degradation was extensive in the rec^- and erx^- strains at doses that reduced survival to 1.0% (33 and 150 ergs/mm² respectively). It was concluded that cessation of respiration of irradiated Escherichia coli is dependent on the integrity of their DNA and not on the radiation sensitivity. (auth)

29700 GENETIC DUPLICATIONS INDUCED AT VERY HIGH FREQUENCY BY ULTRAVIOLET IRRADIATION IN ESCHERICHIA COLI. Hill, C. W.; Combriato, G. (Pennsylvania State Univ., Hershey). Mol. Gen. Genet.; 127: No. 3, 197-214(1973).

It was found that mild ultraviolet irradiation of Escherichia coli leads to a duplication of the gly T pur D region of the chromosome to the extent that 3 to 5% of all surviving chromosomes carry a genetic duplication of this material. The duplications vary in size from less than one to more than five minutes of the chromosome. While the endpoints of the duplications vary, seven of the characterized have one end between the pur D and met A loci, and five of these seven have the other endpoint near the arg H locus. Consequently, the region between pur D and met A (only 0.1 minutes) seems to be particularly prone to participating in abnormal recombinational events. The uv-induced damage leading to the genetic duplications is subject to dark repair, suggesting the involvement of pyrimidine dimers. Other mutagens such as nitrous acid, ethyl methanesulfonate, and nitrosoguanidine are also effective and probably most of the duplications are tandem duplications. However, at least one example was found that is more readily explained by a translocation. (auth)

29701 EFFECT OF UV LIGHT ON FORMATION AND SYNTHETIC CAPACITY OF DNA-MEMBRANE COMPLEXES FROM T7-INFECTED CELLS OF E. COLI. Wintermantel, G. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 25: No. 2, 105-111(Feb 1974).

The action of uv light on the attachment of T7-DNA to the bacterial cell membrane, and the RNA- and DNA-synthesizing activity of the DNA-membrane complex, were investigated. In E. coli H560 cells infected by uv-irradiated T7 phages, the amount of membrane-associated parental ^{32}P-labeled T7-DNA was determined. To measure the RNA- and DNA-synthesizing activity, the isolated DNA-membrane complexes were incubated with an equimolar mixture of the corresponding four nucleoside triphosphates. The uv-sensitivities of the functions tested were calculated from the slopes of the dose-effect curves. In relation to the uv-sensitivity for plaque-forming ability of the T7-bacteriophages they amount to 0.07 (±0.01); 0.15 (±0.01); and 0.56 (±0.04), respectively. (auth)

29702 ENERGY METABOLISM AND REPAIR OF UV-DAMAGE IN SACCHAROMYCES. 2. Calorimetric Measurements of the Glucose Metabolism of uv-Sensitive Mutants. Schaarschmidt, B.; Lamprecht, I. (Freie Univ., Berlin). Int. J. Radiat. Biol.; 25: No. 2, 167-173(Feb 1974).

Enhancement ratios of the surviving fraction after uv irradiation and subsequent liquid-holding period were compared with microcalorimetrically obtained data on the glucose storage in Saccharomyces mutants carrying the genes r_1^1, r_2^1, r_{3-2}^1 and in the wild-type. The survival rates were found to be proportional to intracellular glycogen reservoirs. For diploid cells the enhancement ratios of survival after recovery in buffer supplemented by glucose were related to the cellular rate of catabolic activity of glucose. The influence of glucose, due to its high free energy, was limited by the repair systems in the strains used. Unirradiated and irradiated resting cells showed no differences in microcalorimetric behavior. It is suggested that this indicates a high uv-resistance of the glucose metabolism to doses that reduce survival to less than 1%. (auth)

Radiation Effects on Plants

Refer also to abstract 29806.

29703 (COO-2085-7) EFFECTS OF ACUTE AND CHRONIC GAMMA RADIATION ON CLADONIA SYLVATICA AND PARMELIA SULCATA. Progress Report, March 1, 1973–March 30, 1974. Erbisch, F. H. (Michigan Technological Univ., Houghton (USA). Dept. of Biological Sciences). 1974. Contract AT(11-1)-2085. 31p. Dep. NTIS $4.75.

Data are presented from in vivo and in vitro studies of the effects of γ radiation on usnic acid (a lichen acid); observations of irradiated Cladonia sylvatica podetia during the winter in regards to podetial temperature, photosynthetic rates, and microscopic changes; and macro- and microscopic observations of irradiated Parmelia sulcata in the Enterprise Radiation Forest, Rhinelander, Wisconsin. (CH)

29704 EFFECTS OF DNA AND RNA IN LIVING CELLS AFTER IONIZING IRRADIATION. Lukas, E. (Univ. of Tennessee, Knoxville). pp 461-465 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

Vigna sinensis plants 14 days after the planting of the seeds were irradiated a single time with the doses of 50 to 5,000 R from a ^{60}Co source during 24 hr. Three months after the irradiation, when the plants had reached their full height, they were cut off and frozen in with liquid N. These experiments were repeated 5 times under the same conditions. From the plants of each dose were then extracted the RNA and DNA. The nucleic acids were then hydrolyzed and the nucleotides were then separated by paper chromatography. After localization under the uv light the nucleotides were eluated and hydrolyzed; after evaporation these hydrolyzates were then separated by paper chromatog-

raphy. These chromatograms were also repeated 5 times. From each base respectively nucleotide was then measured a spectrum on the Beckman Spectrophotometer. With the alterations of the single bases respectively nucleotides of the nucleic acids was tried to explain the alterations of growth of these plants corresponding to the single irradiation doses. (auth)

29705 RESULTS IN MUTATION BREEDING OF WHEAT. Hanis, M. Genet. Slechteni; 46: No. 4, 253-260(Oct 1973). (In Czech).

Gamma rays, x rays, or EMS were applied to seeds of seven winter wheat varieties. Frequencies of induced mutations for mildew resistance were found between 0.01 to 0.16, for stripe rust resistance 0.01, and for leaf rust resistance 0.005 mutations per 100 M2 plants. Improved quality of grain occurred at 0.03 and improved yield of grain at 0.004 to 0.0079 frequencies. Mutation rates of diverse morphological mutations are summarized. All the useful mutations exercised a pleiotropic effect, or had concomitant deleterious mutations. (auth)

29706 EFFECT OF RADIATION PROTECTANTS IN RESTORATION OF FERTILITY OF PLANTS IRRADIATED WITH FAST NEUTRONS. Petrov, A. A.; Grodzinskii, D. M.; Tatsii, Yu. A. pp 84-90 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

Pea seeds (Ramonski 77) were irradiated with 800 rads of fast neutrons (LD-37). Comparison of the radiation sensitivity of plants from seeds treated before or after the irradiation with solutions of hydroxylamine hydrochloride, cysteine, iron chloride, a mixture of kinetin and indolylacetic acid, DNA hydrolysate, and crystalline catalase showed that, in the first generation, hydroxylamine, cysteine, catalase, and DNA hydrolysate had the most protective action. These substances restored both the growth and fertility of irradiated plants. (tr-auth)

29707 EFFECT OF FAST NEUTRONS ON THE RATE OF TAKE-UP OF P COMPOUNDS IN PLANTS DIFFERING IN RADIATION SENSITIVITY. Golikova, O. P. pp 106-114 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

The action of fast neutrons on plants of different radiation sensitivities (flax, Artek variety of peas, broad beans) and the effect on the rate of take-up of ^{32}P-orthophosphate by P-containing substances (phospholipids, RNA, DNA, phosphoproteins, and acid-soluble fractions), was studied. Disruption of P metabolism was compared with the manifestation of the final radiation-biological effect, accumulation of dry matter. Irradiation doses that have an unfavorable effect on the accumulation of dry matter in plants was accompanied by depression of the overall P metabolism. When the irradiation was in doses that activate or have no effect on this accumulation, there was no noticeable change in the P metabolism; either the amount of dry matter or the rate of radioactive P take-up increased. Compensatory processes are considered to play an important role in this situation, causing recovery of the plant after radiation damage. (tr-auth)

29708 EFFECTS OF ASCORBIC ACID AND SODIUM AZIDE ON SEEDLING GROWTH OF IRRADIATED AND NON-IRRADIATED BARLEY SEEDS. Conger, B. V. (Univ. of Tennessee, Oak Ridge). Radiat. Bot.; 13: No. 6, 375-379(Dec 1973).

Experiments were designed to test the influence of a radioprotective agent (ascorbic acid) and an agent that enhances radiation damage (sodium azide) on γ-radiation induced seedling growth reduction in barley seeds. It was found that ascorbic acid protects against radiation-induced damage when given as a pre-irradiation treatment but not as a post-irradiation treatment. Sodium azide alone causes seedling injury and appears to enhance the effects of γ radiation. Post-irradiation ascorbic acid-treatment given prior to sodium azide had no effect but soaking after sodium azide in either water or ascorbic acid decreased damage. This latter effect may be important in alternating mutagenic effectiveness, efficiency, and/or spectrum of mutations induced by sodium azide. (auth)

29709 DIFFERENTIAL EFFECT OF SODIUM AZIDE ON THE FREQUENCY OF RADIATION-INDUCED CHROMOSOME ABERRATIONS VS. THE FREQUENCY OF RADIATION-INDUCED CHLOROPHYLL MUTATIONS IN HORDEUM VULGARE. Sideris, E. G. (Democritus Nuclear Research Center, Athens); Nilan, R. A.; Bogyo, T. P. Radiat. Bot.; 13: No. 6, 315-322(Dec 1973).

A considerable synergistic increase of the frequency of cells carrying chromosome aberrations was observed in seeds of Hordeum vulgare, variety Himalaya, irradiated dry with gamma rays and hydrated in sodium azide solutions buffered at pH 3, 7, and 11. This effect, which was most evident at pH 3, was detected throughout development up to the formation of the male gametophyte. No synergistic increase of the frequency of radiation-induced chlorophyll-deficient mutants was observed. This differential effect of the sodium azide post-irradiation treatment on the frequency of chromosome aberrations vs. the frequency of mutations is attributed to the formation of two kinds of lesions in the genetic material of barley following exposure to gamma rays. It is suggested that one kind of lesion, similar to those leading to point mutations in procaryotes, is reparable at low energy potentials and, thus, its frequency is not affected by the sodium azide treatment. The other kind of lesion is attributed to chromosome breaks, its repair being affected by the presence of the enzymatic inhibitor. (auth)

29710 RESPONSE OF SHORTGRASS PLAINS VEGETATION TO GAMMA RADIATION. II. Short-term Seasonal Irradiation. Fraley, L. Jr.; Whicker, F. W. (Colorado State Univ., Fort Collins). Radiat. Bot.; 13: No. 6, 343-353(Dec 1973).

Native shortgrass plains vegetation was given a short-term (30-day) exposure in three seasons; Spring, Summer, and Late-Fall, to gamma radiation with exposures ranging from 517 kR to 8 R. Data were collected through time to permit an analysis of the effects on community structure as measured by coefficient of community and diversity, and recovery stages for 3 yrs after the period of irradiation. The greatest sensitivity was shown by vegetation irradiated in late-fall. In general, the short-grass plains vegetation was found to be very resistant. Fifty percent coefficient of community effects resulted from exposures of 164, 207, and 95.5 kR for the spring, summer, and late-fall exposures respectively. Fifty percent diversity effects resulted from exposures of 57, 143, and 46 kR for the spring, summer, and late-fall exposures, respectively. Recovery was similar to secondary succession with the major exception that some perennials quickly regenerated from underground perennating organs that survived the radiation insult, apparently due to shielding by the soil and/or differential radioresistance of the above and below ground structures. Recovery communities were new, that is, not the same communities that existed prior to irradiation and evidence to date indicates that a long period of time will be necessary before the original communities become re-established. (auth)

29711 REPAIR OF RADIATION DAMAGE IN RELATION TO GROWTH PROCESSES. Howard, A.; Dodd, N. F. J.; Haigh, M. V. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 193-195 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

Spores of the Royal fern, Osmunda regalis, were x-irradiated in the dormant (dry) state and/or in the growing state and tested for reproductive integrity. The results indicate that the spores can accumulate sub-lethal damage but cannot repair it while dormant. The sub-lethal damage can, however, persist, and some of it can be repaired after the spores start to grow. (auth)

29712 RADIOSENSITIVITY OF ROOT MERISTEM CELLS OF CREPIS CAPILLARIS L. GERMS AT DIFFERENT STAGES OF MITOTIC CYCLE. Kaznadzei, V. V. (Inst. of Developmental Biology, Moscow). Genetika; 10: No. 1, 42-52(1974). (In Russian).

The dynamics and ratios of frequencies of chromatid rearrangements (breaks and exchanges) induced in root meristem cells at different stages of the mitotic cycle (during the period from the beginning of the S stage until the late G_2 stage) by x rays in Crepis capillaris seedlings irradiated at different doses were studied. The radiosensitivity of chromosomes was shown to increase during this period, its value at the late G_2 stage being in the average twice that at the S stage. However, the frequencies of exchanges and breaks were observed to change differently, the frequency of isochromatid breaks and translocations increasing much slower, than that of chromatid breaks. The capacity of forming chromatid breaks does not change in chromosomes with increasing irradiation dose, while the capacity of the formation of isochromatid breaks and translocations increases, furthermore, much more rapidly at the S stage, than at the G_2 stage. The change of the frequency of complete isochromatid breaks exhibits the same character, as that pertaining to translocations, i.e., their frequency increases both in the course of the advancing development of cells to the late G_2 stage and with increasing irradiation dose. The frequency of all the types of incomplete isochromatid breaks does not change under controlled conditions, i.e., does not depend either on the irradiation dose, or on the stage of the mitotic cycle. (auth)

Radiation Effects on Animals

Man

Refer also to abstracts 29084, 29202, 29203, 29210, 29294, 29298, 29307–29311, 29354, 29364, 29365, 29372, 29383–29385, 29433,

29606, 29671, 29672, 29687, 29688, 29837, 29844, 30193, 31059, 31061, 31077, 31371, 31372, 31432, 31551–31570, 31572, 31573, 31576–31593, and 31632.

29713 (FDA-73-8029) HEALTH PHYSICS IN THE HEALING ARTS. Seventh Midyear Topical Symposium, San Juan, Puerto Rico, December 11–14, 1972. (Food and Drug Administration, Rockville, Md. (USA)). Mar 1973. 658p. (CONF-721204-). GPO $5.40.

From 7th midyear topical symposium on health physics in the healing arts; San Juan, Puerto Rico, USA (11 Dec 1972).

Separate references were prepared for 89 of the 92 papers included. Four papers were previously abstracted in NSA. For abstract numbers see CONF-721204 in the Report Number Index. (CH)

For abstracts of individual papers see: 28966, 29042, 29373, 29429–29434, 29605–29607, 29714–29751, 29838–29841, 31060–31065, 31071–31074, 31077, 31544, 31552–31573, and 31633.

29714 (FDA-73-8029, pp 5-12) HISTORICAL PERSPECTIVE OF RADIATION PROTECTION. Wald, N. (Univ. of Pittsburgh, PA). Mar 1973.

In health physics in the healing arts.

Problems relating to human health from the use of radiations in medical diagnosis and therapy are reviewed, with emphasis on the hazards of diagnostic radiography. Developments in radiation protection from 1895 through 1971 are reviewed. The role of various national and international organizations in the development of radiation protection standards is discussed. (CH)

29715 (FDA-73-8029, pp 16-24) FACTORS CONTROLLING THE RECOGNITION OF LEUKEMIA AND CHILDHOOD CANCERS. Stewart, A. M. (Oxford Univ.). Mar 1973.

In health physics in the healing arts.

The delayed effects of low-level radiation in relation to the changing patterns of leukemia mortality are discussed and it is pointed out that there has been a long period of false impressions and conflicting theories. The earliest finding of the Oxford survey was statistical evidence of a causal relationship between childhood cancers and leukemia and obstetric radiography, but the relevant observations were followed by so much contradictory evidence from other sources that for many years the Oxford data were ascribed to biased reporting of antenatal events by the mothers of live and dead children. The subsequent discovery of comparable standards of reporting by the two groups of mothers and of radiation effects which were related not only to the amount of radiation received by the fetus but also to the exposure age, and to a series of cancer incubation periods, has made it unlikely that prenatal irradiation does not carry a cancer hazard. The negative findings of several prospective surveys (including a followup of 1,292 A-bomb survivors who were exposed in utero) have never been explained and even epidemiologists express doubts about the validity of the data collected retrospective. It is concluded that no prospective survey is in a position to detect a small number of extra cancers due to prenatal exposure to low-level radiation unless it has kept a complete dossier of in utero deaths and later deaths (to provide a correct basis for calculating expected numbers of nonradiogenic cancers) and a record of how long each child was kept under surveillance. Clearly a followup which allows the whole situation to be reviewed after the youngest child has passed the age of 10 years is preferable to one which had no means of doing this. Even this would be inadequate unless the expected number of cancer deaths in both halves of the followup period were sufficient to draw a distinction between leukemias and solid tumors and to indicate their normal age distributions. (CH)

29716 (FDA-73-8029, pp 25-30) LATE MORTALITY EFFECT OF RADIATION IN MAN. Jablon, S. (National Academy of Sciences, Washington, DC). Mar 1973.

In health physics in the healing arts.

For both ethical and practical reasons the effects of known noxious agents, such as radiation, cannot be evaluated by experiments on humans. Knowledge of radiation effects on rats, mice, and other animals give but uncertain guidance as to effects on man. The recourse is to take advantage of the human experience which is generated, not in the course of the search for knowledge but, for example, by the therapy of ankylosing spondylitis, or by pelvimetry of expectant mothers, or occupationally, as for example, by radiologists. The difficulty with such surveys is that there is no assurance that the irradiated and nonirradiated populations are alike except for the single factor of radiation; as alike, that is, as if the groups had been defined by a randomization process. Patients with spondylitis are surely different from other persons; women who have prenatal x ray exposures are different in a variety of ways from prospective mothers who do not; and physicians who choose to specialize in radiology are different from surgeons. An approximation to a nonselected irradiated population is afforded by the survivors of the Hiroshima and Nagasaki atomic bombs, but even for them the experimental logic is flawed. During 1972 the United Nations Scientific Committee on the Effects of Atomic Radiation published the sixth in their series of so-called UNSCEAR reports and the report of the NAS Committee on the Biological Effects of Ionizing Radiation—(the so-called BEIR report) was published. Both the UNSCEAR and the BEIR reports are based on the idea that cancer is the major long-term somatic effect of radiation on human beings. The BEIR reports states that cancer (including leukemia) induction is the only source of somatic risk that needs to be taken into account in setting radiation protection standards for the general population. It is estimated that the number of deaths per 0.17 rem per year in the entire U.S. population is in the range of 5,000 to 7,000 (or 3,500 per 0.1 rem per year). The risk estimates lack precision but do indicate that the mean dose both to the population and to each individual must be kept as low as practicable. Some of the data that led to this conclusion are reviewed. (CH)

29717 (FDA-73-8029, pp 31-42) PUBLIC HEALTH CONSIDERATIONS OF THE BIOLOGICAL EFFECTS OF SMALL DOSES OF MEDICAL RADIATION. Fabrikant, J. I. (Univ. of Connecticut, Farmington). Mar 1973.

In health physics in the healing arts.

Public health concerns regarding exposure of human populations to manmade radiations resulting from medical applications, such as diagnostic and therapeutic radiology and nuclear medicine, and industrial applications, such as nuclear power plant installations, have received considerable attention. Information on levels of environmental and medical radiation exposure received by the population at present, as well as projected exposure in the future, is reasonably well known and approaches to estimating the attendant risk to the individual and to the human population in general, and efforts to put the potential hazards from radiation exposure to low levels of dosage in context, can help place the concerns of radiation hazards to the public health in proper perspective. For example, it would appear appropriate to compare population exposure from nuclear reactors to that from other well-known sources for generating power, such as fossil fuel plants, or to compare the degree of potential attendant radiation risk with those of other risks encountered in everyday life, perhaps illness or injury. Such comparisons must help us understand the significance of the application and widespread use of new technological developments in our society which must be determined before their social impact can be properly assessed, and before society considers any adjustment of benefit-versus-cost relations to be indicated. The present basis of radiation protection of the health of the public in the United States is essentially the establishment of upper limits for individual and population exposure, and to provide dose-limiting recommendations and guidance for special cases. This implies that any biological risks both to the individual and to the population are offset by commensurate benefits, most frequently to society. Further, the implications are that these risks are kept as low as practicable; that is, the radiation exposure is to be kept at the lowest practicable level, assuming a no-threshold dose-effect relationship obtains. Data on the biological effects of irradiation on man and experimental mammals are reviewed in relationship to age, dose, and pathological effects manifested as a function of time. (CH)

29718 (FDA-73-8029, pp 43-53) ABSENCE OF CYTOGENETIC EFFECTS FOLLOWING X-RAY PELVIMETRY. Bushong, S. C.; Prasad, N.; Werch, A.; Yasunagadec, S.; Glaze, S. (Baylor College of Medicine, Houston, TX). Mar 1973.

In health physics in the healing arts.

X rays have been employed diagnostically in obstetrics since the first decade of this century. As presently employed, there are four principal obstetric x-ray examinations: pelvimetry, placentography, placental angiography, and fetography and by far the most frequently employed examination is x-ray pelvimetry. This examination usually consists of two or more pelvic x rays taken within a few hours before delivery. The x rays are examined to determine cephalopelvic compatibility, and this type of examination is generally ordered by the obstetrician when he suspects difficulty in the passage of the fetal head through the pelvic rim during birth. An attempt was made to measure a response from the neonate to x-ray pelvimetry using chromosomal damage as the biological indicator. The radiation dose during x-ray pelvimetry to 61 patients was estimated and the cytogenetic response of peripheral lymphocytes was determined in 25 of them. This analysis showed no evidence of radiation-induced chromosomal damage in an infant following x-ray exposure in utero. (CH)

29719 (FDA-73-8029, pp 57-60) CHANGES IN COLLIMATION RECORDED IN THE 1964 AND 1970 X-RAY EXPOSURE STUDIES. Gitlin, J. N.; Roney, P. L.; Grossman, L.; Wyckoff, H. O. (Food and Drug Administration, Rockville, MD). Mar 1973.

In health physics in the healing arts.

29720 (FDA-73-8029, pp 61-64) ESTIMATES OF ADDITIONAL DOSE PARAMETERS FROM THE U.S. PUBLIC HEALTH SERVICE'S X-RAY EXPOSURE STUDIES OF 1964 AND 1970. Shleien, B.; Gaskill, J. (Food and Drug Administration, Rockville, MD). Mar 1973.
In health physics in the healing arts.
The radiation dose received by active bone marrow, thyroid, skin surface, and the abdomen at a 10 cm depth was calculated for human patients based on existing data on x-ray exposure during diagnostic radiography. (CH)

29721 (FDA-73-8029, pp 65-70) NATIONWIDE EVALUATION OF X-RAY TRENDS. Leggett, I. P. Jr; Seabron, L. (Food and Drug Administration, Rockville, MD). Mar 1973.
In health physics in the healing arts.

29722 (FDA-73-8029, pp 91-100) DEVELOPMENT OF A DENTAL X-RAY PROTECTION SURVEY TECHNIQUE EMPLOYING THERMOLUMINESCENT DOSIMETERS. Roessler, C. E.; Forsythe, R. J.; Collett, W. K.; Kavanaugh, H. V.; Bolch, W. E. (Univ. of Florida, Gainesville). Mar 1973.
In health physics in the healing arts.

29723 (FDA-73-8029, pp 101-105) COMPARATIVE ABSORBED DOSES IN DENTAL RADIOGRAPHY: IV PEDODONTIC RADIOGRAPHY. Weissman, D. D. (Univ. of California, Los Angeles). Mar 1973.
In health physics in the healing arts.

29724 (FDA-73-8029, pp 107-114) DOSIMETRY STUDY OF DENTAL EXPOSURES FROM INTRAORAL RADIOGRAPHY. Alcox, R. W. (Food and Drug Administration, Rockville, MD). Mar 1973.
In health physics in the healing arts.

29725 (FDA-73-8029, pp 115-122) PATIENT GONADAL DOSE AND FETAL DOSE IN RADIOTHERAPY. Villafana, T. (George Washington Univ. Hospital, Washington, DC). Mar 1973.
In health physics in the healing arts.
The total lymph node irradiation technique using γ or high-energy x radiation for the treatment of Hodgkins disease has greatly increased the survival rate of patients, a significant number of whom are in the child-bearing age. Methods for the reduction of the radiation dose to the gonads and for protection of the fetus during radiotherapy are discussed. (CH)

29726 (FDA-73-8029, pp 142) RETAKES IN DIAGNOSTIC RADIOGRAPHY. Mazzaferro, R. J.; Church, W. W.; Burnett, B. M. (Northeastern Radiological Health Lab., Winchester, MA). Mar 1973.
In health physics in the healing arts.

29727 (FDA-73-8029, pp 143-145) SURVEY OF RADIATION EXPOSURE OF INFANTS IN A NEW BORN SPECIAL CARE UNIT. Muffelman, D.; Scheele, R. V.; Wakley, J.; Agarwal, S. K.; Smith, T. (Univ. of Virginia School of Medicine, Charlottesville). Mar 1973.
In health physics in the healing arts.

29728 (FDA-73-8029, pp 158-162) OPERATIONAL HEALTH PHYSICS IN DIAGNOSIS. St. Germain, J. (Memorial Hospital, New York, NY). Mar 1973.
In health physics in the healing arts.

29729 (FDA-73-8029, pp 175-178) RADIATION PROTECTION IN DIAGNOSTIC RADIOLOGY: REQUIREMENTS, MODALITIES, AND COSTS. Krohmer, J. S. Mar 1973.
In health physics in the healing arts.

29730 (FDA-73-8029, pp 185-194) PHOTOFLUOROGRAPHIC X-RAY MACHINE CHEST EXPOSURES AND SURVEY TECHNIQUES. Repacholi, M. H.; Jack, G. C. (Radiation Protection Bureau, Ottawa, Ont.). Mar 1973.
In health physics in the healing arts.

29731 (FDA-73-8029, pp 200-202) HEALTH PHYSICS IN RADIOTHERAPY. Dobrowolski, F. (Downstate Medical Center, Brooklyn, NY). Mar 1973.
In health physics in the healing arts.
Advances in radiation protection of patients, medical personnel, and hospital visitors during radiotherapy of neoplasms using external beams, implanted radiation sources, or injected radioisotopes are briefly reviewed. (CH)

29732 (FDA-73-8029, pp 222-226) STUDY OF RADIATION EXPOSURE FROM TECHNETIUM-^{99m} GENERATORS AT THREE HOSPITALS. Mayes, M. G. (Environmental Protection Agency, Las Vegas, NV). Douglas, R. L.; Carter, M. W.; Grady, T. M.; van der Smissen, E. Mar 1973.
In health physics in the healing arts.

29733 (FDA-73-8029, pp 227-234) SURVEY OF RADIOPHARMACEUTICAL USE AND SAFETY IN SIXTY-NINE HOSPITALS. Lombardi, M. H.; Beck, W. L.; Cloutier, R. J. (Oak Ridge Associated Universities, Inc., TN). Mar 1973.
In health physics in the healing arts.
In a survey of 69 hospitals averaging 411 beds, ^{99m}Tc was found to be the γ imaging radionuclide most widely used. Approximately 95% of the total hand dose was received during the process of preparation and injection of the scanning agent. Five percent was received during assay. Hand dose during elution was found to be negligible. Thermoluminescent dosimeters on the fingertips of technologists handling ^{99m}Tc under hospital working conditions resulted in a hand dose rate estimate of 0.92 mrem/min-mCi or approximately one-tenth of the rate measured on the surface of a loaded syringe (10 ± 0.2 mrem/min-mCi). Variabilities in geometry and exposure times may account for the difference. Estimated hand dose as derived from TLD measurements on the fingertips of technologists was also determined for procedures using ^{131}I, ^{18}F, ^{67}Ga, ^{133}Xe, ^{75}Se, ^{203}Hg, ^{197}Hg, and ^{85}Sr. The dose reduction afforded by the use of syringe shields is reported. (CH)

29734 (FDA-73-8029, pp 237-240) PERSONNEL EXPOSURE DURING SIMULATED TELETHERAPY UNIT FAILURE. Barish, R.; Vacirco, S. J. (State Univ. of New York, Brooklyn). Mar 1973.
In health physics in the healing arts.

29735 (FDA-73-8029, pp 261) MEASUREMENT OF PATIENT RADIATION IN DIAGNOSTIC RADIOLOGY USING A RAPMETER. Cameron, J. R.; Juhl, J. H.; Bank, M. I.; Szmuk, P. (Univ. Hospitals, Madison, WI). Mar 1973.
In health physics in the healing arts.

29736 (FDA-73-8029, pp 262) EVALUATION OF PHOTOFLUOROGRAPHIC X-RAY MACHINES. Gaeta, N. A.; Halperin, J. A. (Northeastern Radiological Health Lab., Winchester, MA). Mar 1973.
In health physics in the healing arts.

29737 (FDA-73-8029, pp 385-393) DOSE REDUCTION IN DIAGNOSTIC RADIOLOGY BY ELECTRONIC IMAGING TECHNIQUES. Sashin, D.; Sternglass, E. J.; Huen, A.; Heinz, E. R. (Univ. of Pittsburgh, PA). Mar 1973.
In health physics in the healing arts.
The radiation exposure in diagnostic radiology has been reduced in many examinations by the substitution of electronic radiography for standard film techniques. With the development of high resolution electronic imaging components during the last few years, electronic radiographic systems are being built to reduce the radiation exposure to the patient 50 to 200 times, while yielding electronic images with higher resolution than standard spot films in some clinical situations. These systems, in addition to decreasing radiation dose, reduce procedure time, reduce patient trauma, and permit new types of procedures to be undertaken. (auth)

29738 (FDA-73-8029, pp 394-398) DOSE REDUCTION USING PULSED IMAGE FLUOROSCOPY AND SILICON TARGET STORAGE TUBE. Mistretta, C. A.; Kelcz, F.; Ort, M. G.; Cameron, J. R.; Siedband, M. P.; Crummy, A. B.; Friday, R.; Juhl, J.; Wolfson, J. (University Hospitals, Madison, WI). Mar 1973.
In health physics in the healing arts.

29739 (FDA-73-8029, pp 399-402) LOW EXPOSURE CAPABILITIES OF ELECTRONIC RADIOGRAPHY. Miller, W. B.; Baker, V. D. (Emory Univ., Atlanta). Mar 1973.
In health physics in the healing arts.

29740 (FDA-73-8029, pp 403-407) PELVIMETRY WITH NEGLIGIBLE FETAL RADIATION DOSE. Sashin, D.; Yaniv, S. S.; Mazer, J. M.; Sternglass, E. J.; Houser, L. (Univ. of Pittsburgh, PA). Mar 1973.
In health physics in the healing arts.
Polaroid fluoroscopy and electronic radiography for orthometric pelvimetry have been developed to give the required pelvic measurements with one one-hundredth the radiation exposure for film radiography in the direct beam and with one one-thousandth to one ten-thousandths the fetal radiation exposure. In preliminary studies these techniques have shown adequate detail and precision for pelvimetry. (auth)

29741 (FDA-73-8029, pp 409-413) COMPUTERIZED CUMULATIVE DOSE RECORDING SYSTEM. Gileadi, A. E. (Puerto Rico Nuclear Center, Mayaguez). Mar 1973.
In health physics in the healing arts.

29742 (FDA-73-8029, pp 419-422) RADIATION PROTECTION CONSIDERATIONS FOR THE MIMER III AND ROTATING CHAIR. Riley, R. C.; Wegst, A. V. (Univ. of Kansas Medical Center, Kansas City). Mar 1973.
In health physics in the healing arts.

29743 (FDA-73-8029, pp 423) DOSIMETRY FOR TOTAL-BODY IRRADIATION THERAPY. Beck, W. L.; Stokes, T. R.; Lushbaugh, C. C. (Oak Ridge Associated Universities, TN). Mar 1973.

In health physics in the healing arts.

The Oak Ridge Associated Universities (ORAU) Medical Division uses three different total-body γ irradiators for treating disseminated blood diseases, leukemias, lymphomas, and related disorders. These irradiators provide uniform total-body exposures at rates of 1.5 R/hr, 1.5 R/min, and 40 R/min. Because of different source-patient geometry and γ ray energies, the patient's depth dose distribution is not the same in each irradiator. A series of dosimetry experiments using a heterogeneous phantom and a thermoluminescent dose measurement technique were done to determine the complete depth-dose distribution to patients treated in the three irradiators. (auth)

29744 (FDA-73-8029, pp 424) TLD WRIST MONITOR DESIGNED FOR THE ASEPTIC REQUIREMENTS OF SELECTED FLUOROSCOPIC PROCEDURES. Howley, J. R.; Wagner, W. M. (National Inst. of Health, Bethesda, MD). Mar 1973.

In health physics in the healing arts.

29745 (FDA-73-8029, pp 435-441) MOST DRAMATIC AND RADIOSENSITIVE PERIOD IN LIFE: FROM CONCEPTION TO BIRTH. Rugh, R. (Food and Drug Administration, Rockville, MD). Mar 1973.

In health physics in the healing arts.

The development of the human fetus is reviewed. The possibility of congenital anomalies of the infant resulting from exposure during diagnostic radiography of the pregnant mother is postulated. (CH)

29746 (FDA-73-8029, pp 475-478) DIAGNOSTIC ULTRASONOGRAPHY: AN ALTERNATIVE TO X-RAY AND RADIONUCLIDE EXAMINATIONS. Templeton, A. W.; Riley, R. C.; Goldstein, A. (Kansas Univ. Medical Center, Kansas City). Mar 1973.

In health physics in the healing arts.

29747 (FDA-73-8029, pp 588-591) EXPERIENCE IN THE CLINICAL TESTING OF MALE GONAD SHIELDS. Church, W. W. (Food and Drug Administration, Winchester, MA); Burnett, B. M.; Brown, R. F. Mar 1973.

In health physics in the healing arts.

29748 (FDA-73-8029, pp 596-604) CONSIDERATIONS OF POSSIBLE PREGNANCY IN THE USE OF DIAGNOSTIC X RAYS. Boice, J. D. Jr.; Burnett, B. M. (Food and Drug Administration, Winchester, MA). Mar 1973.

In health physics in the healing arts.

29749 (FDA-73-8029, pp 612-616) ASSESSMENT OF PERSONNEL DOSE FROM ^{129}Cs AND ^{99m}Tc IN A NUCLEAR MEDICINE LABORATORY AND RESULTING DOSE REDUCTION TECHNIQUES. Branson, B. M.; Hoops, R. G.; Grant, R. J. (Univ. of Cincinnati). Mar 1973.

In health physics in the healing arts.

29750 (FDA-73-8029, pp 617-619) SAVE A ROENTGEN CAMPAIGN. Harris, S. J. (N. Y. City Dept. of Health, NY). Mar 1973.

In health physics in the healing arts.

29751 (FDA-73-8029, pp 623) REDUCTION OF RADIATION DOSE TO THE PATIENT IN DIAGNOSTIC RADIOLOGY. Cameron, J. R. (Univ. Hospitals, Madison). Mar 1973.

In health physics in the healing arts.

29752 (FDA-73-8047) POPULATION EXPOSURE TO X RAYS, U. S. 1970. (Food and Drug Administration, Rockville, Md. (USA)). 1970. 137p. GPO.

The X-ray Exposure Study conducted by the U. S. Public Health Service was designed to produce estimates of the x-ray experience of the U. S. population in 1970. A similar study was performed in 1964, and some of those results are reproduced in this report. In addition to the principal findings, this report contains a description of the background, objectives, design, methods, and procedures used in the study to produce estimates of exposure for a variety of personal and demographic characteristics of the U. S. population. In addition, the study design provided a basis for estimating specific organ and genetic dose for x-ray exposure when used with models developed through research at several universities. X-ray visit data were obtained from a representative sample of the U. S. population through a supplementary questionnaire included in the Household Interview Survey, a continuing program of the National Center for Health Statistics. A sample of approximately 67,000 people in 22,000 households provided this information during the period April to September 1970. The study showed that: the estimated mean exposure per film for posterior-anterior and anterior-posterior views of the abdomen increased from an estimated 480 mR in 1964 to 620 mR in 1970; the estimated mean exposure per film for radiographic PA chest examinations remained about the same, approximately 28 milliroentgens in 1964 and 27 in 1970; and there was a 20-percent decrease in the mean exposure per dental film from an estimated 1,140 mR in 1964 to 910 mR in 1970. (CH)

29753 (LA-tr-74-7) PARTICLE RAYS IN MEDICINE. Part II. Chorskov, V. S.; Dzelepov, V. P.; Goldin, L. L.; Lomanov, M. F.; Savcenko, O. V.; Tesch, S. Translated from Wiss. Fortschr.; 23: 347-353(1973). 23p. Dep. NTIS $3.25.

The first test phase for the clinical application of proton and α rays for treatment of malignant tumors is completed. Heavy, charged particles make it possible to obtain a dose field in depth and diameter with an exactness that cannot be achieved with other methods. If irradiation methods are developed on the basis of protons, the whole system of treating oncological diseases must be changed. The accelerator is used in an economical way only if several treatment rooms are arranged around it. Under these conditions, one accelerator is sufficient for a large number of patients drawn from a large population. (CH)

29754 (NP-19938, pp vp, Paper 11) PRINCIPLES OF RADIATION PROTECTION. Aurand, K.; Ruehle, H.; Schmier, H. (Bundesgesundheitsamtes, Berlin). Nov 1971. (In German).

The rad, Roentgen, Curie, and dose equivalent are defined. The maximum permissible dose and concentration under normal and catastrophic conditions are defined and discussed. (JSR)

29755 (TID-26552) PROTECTION AGAINST RADIATIONS FROM CALIFORNIUM-252. (USAEC Division of Biology and Medicine, Washington, D. C.). 1970. 38p. Dep. NTIS $5.00.

Many ^{252}Cf sources are now being employed for a variety of purposes and it appears likely that their number will increase greatly in the near future. Sources of neutrons utilizing the spontaneous fission processes are superior to other neutron sources previously used in that they are more compact, economical, and reliable, and consequently they are useful in a variety of new applications in technology and medicine. This document was prepared to serve as a guide to radiation protection officers and to workers employing ^{252}Cf neutron sources, with special emphasis on medical utilization. (CH)

29756 CALCULATION OF DOSE DISTRIBUTION FOR CHEST WALL IRRADIATION USING B-MODE ULTRASONOGRAPHY. Ekstrand, K. E.; Dixon, R. L.; Blake, D. D.; Raben, M. (Wake Forest Univ., Winston-Salem, NC). Radiology; 111: No. 1, 185-187(Apr 1974).

B-mode ultrasonography was used to determine chest wall dimensions for radiotherapy treatment planning. The ultrasonograms reveal the inner surface of the chest wall and the anterior surface of the sternum in relation to the skin. Using this information, dose distributions for ^{60}Co tangential breast irradiation are calculated. (auth)

29757 OSTEOSARCOMA OF THE PELVIS FOLLOWING RADIOTHERAPY FOR CARCINOMA OF THE CERVIX. Rushforth, G. F. (Royal National Orthopaedic Hospital, Stanmore, Eng.). Brit. J. Radiol.; 47: No. 554, 149-152(Feb 1974).

A case history is presented of osteosarcoma of the pelvis, diagnosed in a 54 yr old woman 9 yrs after radiotherapy for carcinoma of the cervix. The literature is reviewed for similar cases. (UK)

29758 TREATMENT OF RADIONECROSIS OF FLEXOR FOLDS (AXILLA, GROIN, AND NECK), USING THE GREAT OMENTUM SUPPORTING DERMO-EPIDERMAL FREE FLAPS. Kiricuta, I. (Inst. of Oncology, Cluj). Ann. Chir. Plast.; 18: No. 1, 65-73(1973). (In French).

An original procedure for the treatment of flexor fold radionecrosis, using the great omentum as a plastic material has been described. After the size and vascularization of the great omentum have been assessed by laparotomy, the radionecrotized tissues are extensively removed, the great omentum is taken out from the abdomen and the excised area filled up. The omentum is covered with split thickness skin grafts. Radionecroses of the cervical (pharyngostoma), supraclavicular, axillary and inguinal areas, have been successfully treated with this original procedure by the author. Experimentally, transplantation of the great omentum to the neck has been successful in dogs, an anastomosis being performed between the gastro-omental artery and vein and the cervical vessels. (auth)

29759 VALUE OF SCINTISCANNING IN THE DIAGNOSIS OF CEREBRAL, RENAL, AND HEPATIC NEOPLASIAS IN PEDIATRICS. Mussa, G. C.; Martini Mauri, M.; Bacolla, D. (Univ., Turin). pp 243-247 of Malignant Diseases and Radiology Medicine. Vol. 14. Vienna; Wiener Medizinisch Akademie (1971).

There is no particular objection to the use of scanning because the technique is free from toxicity, harmless, and easy to use. In the pediatric age and in the early months of life scanning is successful in the resolving of diagnostic problems. By this method the effects of antiblastic therapy may be followed up over a period. (INIS)

29760 FACTORS OF SIGNIFICANCE FOR RADIATION REACTIONS. Devik, F. (Statens Institutt for Straalenhygiene, Oslo). pp 307-311 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

Significant factors in individual reactions to radiation, such as biological variations, age and sex, the size of the irradiated area, and the radiation doses' distribution in time are discussed. The effect of biological repair and regeneration are considered. The effect of the presence of oxygen is discussed as is that of radiation quality. Finally protective substances and sensitizing substances are briefly treated. (NO)

29761 DELAYED INJURIES. Devik, F. (Statens Institutt for Straalenhygiene, Oslo). pp 312-317 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

The late effects of ionizing radiation in inducing leukemia and other forms of cancer are discussed and illustrated by statistical tables. The effect on mortality statistics is also discussed briefly. (NO)

29762 GENETIC CHANGES FOLLOWING IRRADIATION. Devik, F. (Statens Institutt for Straalenhygiene, Oslo). pp 318-322 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

The induction of gene mutations and chromosome anomalies by ionizing radiation is discussed. The long term effect of such genetic damage is evaluated briefly. (NO)

29763 HUMAN RADIATION CYTOGENETICS. Special Reference to Human Chromosomes. Awa, A. (Atomic Bomb Casualty Commission, Hiroshima). Shoni Igaku; 6: No. 1, 185-216 (Jan 1973). (In Japanese).

The topics discussed include relationship between cell cycle and the incidence of chromosome aberration; various types of aberration; lymphocyte culture; relation of cultured lymphocyte with radiation-induced chromosome aberration, especially with radiation dosage. The types of chromosome aberration vary depending upon the period of cell cycle exposed to radiation. Those that are irradiated during mitosis form chromatid type aberration when exposed after S period and chromosome type aberration when exposed in G_1 and the first half of S period. Those exposed during interphase form exchange aberration due to misrepair. Chromatid type aberration includes single chromatid aberration, and isochromatid aberration ranging from isochromatid break to complete and incomplete repair. Chromosome type aberration is further divided into single break and compound break. Single break is characterized by terminal deletion with formation of acentric fragments. Compound break is divided into intrachange including paracentric inversion, acentric ring and interstitial deletion, pericentric inversion, and ring and acentric fragment; and interchange including reciprocal translocation and dicentric chromosome and acentric fragment. The characteristics of lymphocyte culture are: (1) lymphocytes are generally in the earlier stage of DNA synthesis, thus are fairly homogeneous; (2) addition of PHA (phytohemagglutinin) stimulates DNA synthesis, causing first mitosis 48 hrs after beginning of culture and the second, 72 hours; (3) an assumption is made that some lymphocytes stay alive for years without loosing immunological activity. These are important keys to the qualitative as well as quantitative studies of radiation-induced chromosome aberration. No significant difference due to dose rate is observed. However, the kinds of radiation results in varied rate of incidence of aberration; RBE of neutrons in relation to chromosome aberration proved to be two to three times higher than x rays or gamma rays. (JA)

29764 DOSE MEASUREMENTS AND RADIATION PROTECTION MEASURES IN GYNECOLOGICAL RADIUM THERAPY FOR MEDICAL-TECHNICAL ASSISTANTS AND NURSING STAFF. Schmidt, B. Mannheim, Ger.; Univ. Heidelberg (1971). 67p. (In German).

Thesis.

Appropriate measures to decrease radiation exposure of medical-technical assistants and nursing staff of hospitals with radiotherapy departments require personnel dose measurements during the different working operations. The measured values were in all cases below the maximum permissible doses; they are presented in tabular form for the various operations. Proposals are made for a further reduction of radiation exposure in particular fields of application. (GE)

29765 RADIATION THERAPY. Jetne, V. (Statens Institutt for Straalenhygiene, Oslo). pp 105-144 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

A brief historical review of radiotherapy is followed by a presentation of the effects of photons on biological tissues and factors affecting the radiosensitivity of cells. Survival curves for tumors and healthy tissues and for cells in oxygen free and oxygen rich environments are given and discussed. Fractionated irradiation and the time factor are also discussed. Methods of estimating and calculating the radiation effects from isoeffect curves and Ellis' formula are presented. Radiation sources used in radiotherapy, cobalt, radium, linear accelerators, and betatrons are then described and their applications discussed. Various irradiation techniques and depth dose distributions are described and the planning of dose and dose distribution dealt with in some detail. Guidelines for working with radiation equipment conclude the chapter. (NO)

29766 RADIATION EFFECTS. Devik, F. (Statens Institutt for Straalenhygiene, Oslo). pp 272-306 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

Since $^3/_4$ of the human body consists of water, the effect of ionizing radiation on water is first described. Thereafter the effect on other molecules is considered, such as the nucleic acids. The effects at the cellular level are then discussed, on cell nuclei and cytoplasma, cell division, and chromosome damage. The effects on organs and tissues are then considered, commencing with discussion of radiation sensitivity. The effects on blood and bone marrow are discussed at some length, as are the effects on the mucous membrane of the small intestine and the skin. Effects on other mucous membranes, glands, liver, lungs, kidney, and other organs and tissues are treated more briefly. Injuries to fetuses are discussed and the symptoms and treatment of radiation sickness described. (NO)

29767 THROMBOSIS OF THE SUBCLAVIAN-AXILLARY ARTERY FOLLOWING RADIOTHERAPY FOR CARCINOMA OF THE BREAST. Mavor, G. E.; Kasenally, A. T.; Harper, D. R.; Woodruff, P. W. H. (Royal Infirmary, Aberdeen, Scotland). Brit. J. Surg.; 60: No. 12, 983-985 (Dec 1973).

Two cases of subclavian-axillary-brachial artery occlusion following irradiation damage are reported. Both followed radiotherapy for carcinoma of the breast at intervals of 11 and 26 yrs respectively. The results appear to show that large and medium artery sclerosis following irradiation is slowly progressive, leading to final thrombosis not only long after the initial insult but at an extremely variable interval. The prognosis, which is related to the extent of the occlusion and the progressive peripheral ischemia, is not good unless reconstructive arterial surgery is feasible. (UK)

29768 HEALTH PHYSICS OPERATIONAL MONITORING. Volume 1. 3rd Health Physics Society Midyear Topical Symposium, Los Angeles, California, January 29–31, 1969. Willis, C. A.; Handloser, J. S. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1972). 816p. (CONF-690103-P1).

Separate abstracts were prepared for the 40 papers presented at the symposium that are included in the first volume. A special address on future opportunities in health physics is also included. (HLW)

For abstracts of individual papers see: 29210, 29271, 29312, 29386, 29769–29777, 29854–29858, 29868, 29869, 30197–30205, 30224–30229, 31059, 31371, 31372, 31576, and 31577.

29769 HEALTH PHYSICS EXPERIENCES IN NUCLEAR REACTOR, WEAPON, ROCKET, MEDICINE, AND WASTE DISPOSAL PROGRAMS. Wilcox, F. W. (Sutter Community Hospitals, Sacramento, CA). pp 29–45 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Experiences in a variety of operational health physics monitoring programs derive fundamental principles for conducting radiation surveillance, data recording, and protection activities. Ever-increasing use and varieties of sources of radiation require continuous evaluation of monitoring programs. Considerations are type and level of radiation source, attendant chemical and physical hazards, type of individual that will be exposed, management philosophy, availability and adequacy of monitoring instrumenta-

tion, protective equipment and source of laboratory and instrument maintenance support. The responsible health physicist seeks to improve monitoring techniques and strives for a reasonable, practical and economical program that adequately protects the worker, the general public, and his environment while balancing risks versus potential gains from nuclear energy. One such challenge is the need for a meaningful external radiation dosimetry system that relates to permissible absorbed dose to the critical organs. (auth)

29770 HEALTH PHYSICS PROGRAM FOR A PLUTONIUM FUEL FABRICATION FACILITY. McConnon, D. (Battelle Pacific Northwest Labs., Richland, WA). AT(45-1)-1830. pp 89-108 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

A review of the radiation protection program in place at the Plutonium Fuels Laboratory is presented. The facility is described with particular emphasis placed on those design features such as ventilation, construction materials, equipment location, and traffic patterns, which aid in contamination and personnel exposure control. Health physics procedures including air sampling techniques, personnel dosimetry, waste disposal practices, and the routine radiation monitoring surveillance program are described. The importance of rigidly adhered to administrative procedures and thorough personnel training in relation to contamination control, reduction of personnel exposure, and nuclear safety is stressed. Finally, a description is presented of the emergency procedures and equipment in place at the facility for coping with serious contamination spreads, personnel contamination, fire, contaminated injuries, and a critical radiation event. (auth)

29771 OPERATIONAL MONITORING IN A HOSPITAL. Prince, J. R. (Kansas City General Hospital, MO); Pick, M. pp 165-178 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Operational monitoring, as broadly conceived, is concerned with the continuing assessment of the quality of a Health Physics program. With this in mind, the broader aspects of operational monitoring in a hospital situation are described. Topics discussed include program philosophy and administration; employee and patient monitoring; basic equipment needs, radiation source inventory and control, etc. Those problems attendant to patient monitoring and protection with regard to the use of radiopharmaceuticals are emphasized. (auth)

29772 FACILITY MONITORING PROGRAMS, TECHNIQUES, AND PROBLEM SOLVING. Meinhold, C. B. (Brookhaven National Lab., Upton, NY). pp 363-371 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

In house activities of applied health physics programs are considered. Topics discussed are hazard potential of radioactive material, radioisotopes, and accelerator beams; facility design for radiation shielding, ventilation and other needs; assistance availability; degree of regulatory latitude; and specific programs for the radiation safety of a 5 MW modified swimming pool reactor, kilocurie plant irradiation cells, kilocurie field source, x-ray equipment, a 48-patient hospital, and many experimenters using microcurie to millicurie quantities of radioisotopes, the High Flux Beam Reactor, and the Alternating Gradient Synchrotron. (HLW)

29773 SAFE SPECIFIC ACTIVITY: A USEFUL CONCEPT IN MONITORING AREAS CONTAINING ACTIVATED MATERIALS. Willis, C. A. (McDonnell Douglas Astronautics Co., Santa Monica, CA). pp 373-383 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

A new concept, the safe specific activity, is introduced, the limitations on its applicability are specified, and several values are presented. This concept has proved useful in the Hallam and Piqua Nuclear Power Facility dismantelment operations and is applicable to many operations involving large quantities of low-level materials. The safe specific activity guide is conceptually quite simple: if a specific activity is so low that replacement of all the human body with the activated element would not produce a maximum permissible body burden, then the material cannot produce an overexposure by being deposited in body organs. Safe specific activity values of interest include 0.015 μCi ^{3}H per gm H, 0.002 μCi ^{14}C per gm C. 0.01 μCi/gm for ^{22}Na, 0.075 μCi/gm for ^{36}Cl, and 0.25 μCi/gm for ^{41}Ca. This guide must be used with discretion because it does not account for external radiation, lung dose, or gastrointestinal tract dose. In many cases of practical importance, however, meeting the safe specific activity guide is sufficient to ensure safety. Further, safe specific activity values based upon lung, GI tract, and external dose considerations can be obtained easily with the expressions presented in this paper. These expressions refer to the activity per gm of material rather than to the activity per gm of element. (auth)

29774 GUIDELINES FOR DETERMINING FREQUENCY OF WIPE SURVEYS. Deigl, H. J. (Cornell Univ., Ithaca, NY). pp 385-396 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Legal aspects of the transfer, possession, and use of radioactive material at Cornell University are discussed. The importance of maintaining records of wipe surveys is emphasized. Factors to be considered in determining the frequency of wipe surveys were the radionuclide used, activity, area, and procedure. As a guide used to determine hazard, a standard radiotoxicity table was used. A table showing classes of radioisotopes according to toxicity is presented. A list of rules for radiation personnel with regard to wipe surveys is presented. (HLW)

29775 EVALUATION OF RADIATION EXPOSURE. Caldwell, R. (Nuclear Materials and Equipment Corp., Apollo, PA). pp 563-612 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Characteristics of the ethical and the practical health physicist are described. Recommendations of the ICRP and ICRU are discussed and difficulties and similarities of external vs. internal exposure are described. External radiation exposure is discussed with regard to direct measurement of the dose equivalent, use of LET spectrum to obtain the dose equivalent neutron exposure, and rad vs. roentgen. Internal radiation is discussed with regard to metabolic pathways, breathing zone air sampling, inhalation exposure from surface contamination, solubility of inhaled particles, excretion models, and bioassay vs. whole-body counting. (HLW)

29776 RADIATION SAFETY IN THE NUCLEAR INDUSTRY. Sternhagen, C. J. (Kerr-McGee Corp., Oklahoma City, OK). pp 613-650 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Industry is concerned with the radiological health problems present in mines, mills, fuel processing plants and power reactors. Environmental and personnel monitoring methods are changing rapidly with the introduction of new instruments. Pitfalls in true measurement accuracy are found to be greater than has been generally reported, and believed. Pitfalls of bio-assay interpretation exist throughout the ore to radioactive fuel cycle, especially in the fate of insoluble random-sized particles. Newer projects include the wider monitoring of human biological indicators such as the bronchial cells in uranium miners' sputa. In New Mexico's Ambrosia Lake region these cytology examinations correlate with chest x-ray findings, both showing that in this region, which has customarily employed good ventilation practices, there has been little or no lung cancer to date. A thorough data acquisition study is underway for further correlating physical findings with radiation exposures, occupational history, smoking and disease incidence. Radiation exposure and effects may possibly be correlated further by advanced studies just begun involving facial hair, blood and personnel dosimeter readings. Radiation safety is also being furthered with rapid success in personal dosimetry and the nearly instantaneous monitoring of working levels for better ventilation control. (auth)

29777 DETERMINATION OF RADIATION EXPOSURE DOSE TO PATIENTS AND PERSONNEL DURING ELABORATE CINEFLUOROGRAPHIC PROCEDURES. Watts, F. C.; Whitley, J. E.

(Wake Forest Univ., Winston-Salem, NC). pp 677-687 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Cine-radio-fluorographic and rapid sequence filming procedures were studied using thermoluminescent dosimetry. The radiation dose received by patients undergoing special x-ray examinations was considerably greater than that received during routine procedures. However, the dose was within accepted limits and was not believed to be high enough to cause permanent injury. It is recommended that both copper and aluminum be utilized in diagnostic x-ray units. (HLW)

29778 HEALTH PHYSICS OPERATIONAL MONITORING. Volume 2. 3rd Health Physics Society Midyear Topical Symposium, Los Angeles, California, January 29–31, 1969. Willis, C. A.; Handloser, J. S. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1972). 501p. (CONF-690103-P2).

Separate abstracts were prepared for each of the 34 papers included in this volume. (MCG)

For abstracts of individual papers see: 29278, 29313, 29337, 29338, 29478–29492, 29515, 29516, 29779–29782, 29844, 29845, 29859, 30196, 30223, 30238, 31276, 31277, and 31373.

29779 CONTROL AND MEASUREMENT OF HAND EXPOSURE. Carpenter, G. D.; Howell, W. P. (Battelle Pacific Northwest Labs., Richland, WA). AT(45-1)-1830. pp 1199-1213 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

Because limits for extremity radiation exposure dose are much larger than those for whole body dose, it is sometimes assumed that extremity dose control does not require much attention. This may be true where exposures are entirely in relatively uniform fields of radiation, but where the extremities may be exposed to much greater levels of radiation than the whole body, a program of control and measurement of these doses is required comparable to that used in control and measurement of doses to other organs. The hands are the extremities most often exposed to radiation levels not reflected in the results of dosimeters worn for measurement of whole body dose. In many cases, the hands may be in direct contact with radioactive materials for significant periods of time. Because of inherent difficulties in obtaining accurate contact measurements on such materials, the health physicist is sometimes required to make special evaluations of hand exposures for a given work project. This paper describes the basic methods and techniques used in controlling and measuring hand exposure in a large laboratory. (auth)

29780 CONTROL OF PERSONNEL EXPOSURES TO EXTERNAL RADIATIONS IN A PLUTONIUM CHEMICAL PLANT. Owen, J. B. (Dow Chemical Co., Golden, CO). Contract AT(29-1)-1106. pp 1215-1222 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

This paper describes a practical approach to the control of personnel exposures to external radiations in a chemical plant handling kilogram quantities of Pu in glove boxes. Calculated dose rates from various processing operations are compared to measured dose rates. Shielding materials for x-rays, γ rays, and fast neutrons and their economic and operational impact are discussed. Personnel training, rotation, and work habits must be considered in maintaining exposures below the accepted guide levels are included. (auth)

29781 PLUTONIUM: PERSONNEL EXPOSURE CONTROL WITH INCREASING ^{240}Pu CONTENT. Carpenter, G. D. (Battelle Pacific Northwest Labs., Richland, WA). Contract AT(45-1)-1830. pp 1223-1233 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

In recent years there has been a marked increase in the use of commercially recycled plutonium in fuel element fabrication programs. Commercially recycled plutonium has a higher ^{240}Pu content than does the plutonium which has been available in the past. This higher ^{240}Pu content results in increased photon and neutron dose rates which are sufficient to require modification of exposure control practices and procedures. This paper discusses some of the modified procedures which have been put to use at the Pacific Northwest Laboratory to effectively maintain personnel dose within the regulatory limits. (auth)

29782 EXPOSURE AND CONTAMINATION CONTROL IN A HIGH-LEVEL ^{147}Pm LABORATORY. Greenhouse, N. A.; Silver, W. J. (Univ. of California, Livermore). pp 1267-1280 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

A research program at the Lawrence Radiation Laboratory, Livermore, involved handling of kilocurie quantities of ^{147}Pm in the development of radioisotope power sources. A high-level plutonium laboratory was reorganized for this work. The low energy of the ^{147}Pm β necessitated development of special techniques for continuous air monitoring and contamination control. An LRL-designed air monitor and a shoe counter using large-area G. M. detectors are described. Assembly of the power sources involved delicate work which could not be done remotely. Hand exposures from bremsstrahlung and γ-emitting impurities became the limiting health physics problem. Experiences in exposure and contamination control are discussed. (auth)

29783 HEALTH PHYSICS OPERATIONAL MONITORING. Volume 3. 3rd Health Physics Society Midyear Topical Symposium, Los Angeles, California, January 29–31, 1969. Willis, C. A.; Handloser, J. S. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1972). 553p. (CONF-690103-P3).

Separate abstracts were prepared for 32 of the 33 papers presented in this volume. The other paper discusses the educational and career opportunities for radiological health technicians. (ERB)

For abstracts of individual papers see: 29270, 29279, 29314, 29493, 29652, 29860–29862, 30206, 30211, 30212, 31068, 31069, 31374, 31441, 31550, and 31578–31593.

29784 TREATMENT OF TROPHIC ULCER AND BED SORES BY MEANS OF RADIOACTIVE APPLICATORS WITH ^{32}P, ^{204}Tl, AND ^{90}Sr. Kosharko, K. A.; Tel'nov, Yu. A.; Kovtun, N. N.; Timofeev, L. V. (Voronezh Medical Inst., USSR). Med. Radiol.; 19: No. 3, 33-35(Mar 1974). (In Russian).

The authors used applicators ^{32}P, ^{204}Tl, and ^{90}Sr for the treatment of trophic ulcer and bed sores. It is recommended to administer one-time doses of 75 rad and cumulative doses of more than 1000 rad. The described method of treatment yields positive results in 85 patients, i.e., in 59 cases epithelization of ulcers was observed only from one course of β-therapy. (auth)

29785 RADIATION REACTIONS AND COMPLICATIONS IN COMBINED RADIATION THERAPY OF CERVIX UTERI CANCER. Kostromina, K. N.; Titova, V. A. Med. Radiol.; 19: No. 3, 26-33(Mar 1974). (In Russian).

The analysis of radiation reactions of the gastrointestinal tract in combined radiation therapy in 151 patients suffering from cervix uteri cancer of the I to III degrees is given. Radiation therapy was carried out under static conditions of a two- and four-field irradiation on the apparatus "Luch-P", "Rokus" and linear amplifier with the energy of 5 MeV and intracavitary therapy according to an afterloading principle. The paper also describes some nosological forms of radiation pathology of the intestine-rectosigmoiditis, spastic enterocolitis, their clinical course and means of conservative therapy. It presents recommendations for individual planning and performing telegammatherapy, conditions of fractionating radiation dose, and also optimal levels of cumulative absorbed doses (from 3800 to 4000 rad) in the lateral regions of parametral cellular tissue. (auth)

29786 RADIATION LOADING IN ROENTGENOCARDIOLOGICAL INVESTIGATION OF CHILDREN. Krongauz, A. N.; Khomutova, M. G.; Lepskaya, E. S.; Golonzko, R. R.; Ivanitskii, A. V. (Moscow Scientific-Research Roentgene-Radiological Inst.). Med. Radiol.; 19: No. 3, 14-19(Mar 1974). (In Russian).

A comparison of dosimetric characteristics and diagnostic possibilities of various roentgenological methods in complex clinical observations over children suffering from heart diseases is given. It also presents dosimetric measurement in roentgenological treatment of 66 children with congenital and acquired heart diseases. The authors propose a more expedient complex of roentgenocardiological methods taking into consideration radiation safety of a pediatric clinic. (auth)

29787 ANGIOGRAPHIC EXAMINATION OF RADIATION-DAMAGED KIDNEYS. Animal Experiments and Clinical Investigations. Bargon, G.; Reichelt, H. (Medizinische Hochschule, Hanover). Fortschr. Geb. Roentgenstr. Nuklearmed.; 120: No. 1, 55-60(Jan 1974). (In German).

The angiographic findings in radiation-induced renal damage are described, based on observations of a single patient and of animal experiments. The changes observed in the arteriogram are compared with the morphological changes in the vessels. It is emphasized that neither the morphological nor the angiographic changes can be regarded as typical and characteristic of radiation-induced vasculopathy. Similar lesions are found in vasculopathies due to other causes. The presence of vascular changes in the renal arteriogram (variations in calibre, irregularities of vascular distribution, pruning of peripheral vessels, distortion of vessels, and aneurysms) in a patient who had received abdominal irradiation permit the conclusion to be made that the kidney changes are due to the irradiation. Renal angiography should be used more extensively for the diagnosis of radiation damage to the kidney. (auth)

29788 CLONES, MICROCOLONIES, OR TUMORLETS IN IRRADIATED LUNG. Cohen, L. (Michael Reese Hospital, Chicago). Brit. J. Radiol.; 47: No. 554, 154(Feb 1974).

Brief comment is made on the suggestion that nodules formed in irradiated lungs represent discrete clones formed when the depleted tissues are repopulated by the progeny of single surviving cells or small clusters of clonogenic cells. This hypothesis was tested by the cell population kinetics theory, using parameters appropriate to the human lung and the RADLOG computer programme. It is calculated that repopulation of the available space in the depleted tissue would generate a clone of the same size as tumourlets observed in irradiated lung patients. (UK)

29789 PROBLEMS COMMON TO RADIODIAGNOSIS, RADIOLOGICAL PHYSICS, AND RADIOBIOLOGY. Rausch, L. (Univ., Giessen, Ger.). Fortschr. Geb. Roentgenstr. Nuklearmed.; 120: No. 1, 1-11(Jan 1974). (In German).

There has been considerable discussion recently regarding the scientific basis underlying radiation protection. Measures to this effect will be introduced on an international basis and the following considerations have been brought forward: It is not generally realized that x-ray diagnosis is approaching a critical situation that will have various effects. It will be necessary to estimate the risks to patients, and to judge how much radiation can justifiably be given. The development of radiodiagnosis at present carries with it the need for further evaluation. Radiologists are not adequately prepared for the problems, since their interests are predominantly medical and of specific diagnostic type, whereas the wider considerations arising from radiological diagnosis must be judged against a broader scene and require other branches of science for their full evaluation. Appropriate solutions to these problems will have to be found. This will require co-operation between diagnostic radiologists, radiation physicists, and radiation biologists to a much greater extent than hitherto. An effective system for balancing the useful against the detrimental results will have to be developed. This will ensure that diagnostic radiology, based on rational and quantitative considerations, is of overall benefit to mankind. (auth)

Vertebrates

Refer also to abstract 29407.

29790 (BNWL-1850(Pt. 2), pp 79-83) EFFECTS OF TRITIUM ON AQUATIC ENVIRONMENTS. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

The release of tritiated water (HTO) by nuclear reactors has stimulated interest in studies of accumulation and effects in aquatic organisms, particularly the more radiosensitive embryonic and larval life stages. In continuing studies of the chronic effects of tritium as HTO, antibody synthesis in response to C. columnaris and A. salmonicida was used to investigate the effects of tritium irradiation on maturation of the immune process in juvenile and adult rainbow trout. Electrophoresis was performed to determine the potential for qualitative and quantitative shifts in serum proteins, which conceivably account for the reduced immune competence in irradiated test fish. (auth)

29791 (CEA-CONF-2543) STUDY OF PURIC AND PYRIMIDIC COMPOUNDS IN URINE OF RABBITS AND RATS AFTER IRRADIATION. Valle, C.; Pepin, G.; Duprey, F.; Breuil, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). [nd]. 6p. (CONF-730907-24). Dep. NTIS (U. S. Sales Only) $3.00.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

A chromatographic technic is described that was developed to study the urinary excretion of nucleic acid catabolites in rats and rabbits after whole-body lethal γ irradiation. The results obtained for those metabolites that the chromatographic method had shown to change after irradiation are presented. These included uric acid and hippuric acid. (auth)

29792 (CEA-N-1678) GONAD INVOLUTION IN RATS AFTER ^{60}Co AND NEUTRON IRRADIATION. Lemaire, G.; Grillon, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Nov 1973. 37p. (In French). Dep. NTIS (U. S. Sales Only) $5.00.

The LD50 (30 days) and the corresponding RBE (1.8) of male SPRAGUE-DAWLEY rats were determined. A model was developed for the testicle involution occurring after the irradiation (a one-hit-two target pattern for γ rays, a one-hit-one target pattern for neutrons from the Harmonie reactor). Neutrons were used to establish the heterogeneity of the seminal cell populations of the rat. It is then shown that the experimental values obtained for the RBE coefficients corresponding to loss of weight of the male gonads vary inversely with the γ ray dose received. This result agrees with the dualistic theory of Kellerer and Rossi. It is concluded that the cell counts obtained using this technique should enable weak dose levels to be explored, such levels being of particular interest in the field of health physics and studies of basic mechanisms (RBE and dose). (FR)

29793 (CERN-74-3) ANALYSIS OF THE WEIGHT LOSS OF MOUSE TESTICLES AFTER IRRADIATION WITH NEUTRONS AT 14 AND 400 MeV. Laurent, J. M. (European Organization for Nuclear Research, Geneva (Switzerland)). 24 Feb 1974. 15p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

The weight loss of mouse testes 28 days after irradiation with x rays, 14 MeV neutrons, and 400 MeV neutrons was determined. A mathematical model is proposed for evaluating cellular survival curves from the results obtained. The relative biological effectiveness (RBE) determined by employing the Do value for the survival curve is 2.17 for 400 MeV neutrons and 2.58 for 14 MeV neutrons. (tr-auth)

29794 (COO-2269-5) KINETIC AND BIOCHEMICAL STUDIES ON TUMOR GROWTH. Comprehensive Progress Report, October 1, 1967-April 1, 1974. Dethlefsen, L. A. (Utah Univ., Salt Lake City (USA). Dept. of Radiology). 1974. Contract AT(11-1)-2269. 16p. Dep. NTIS $4.00

The antigenic status of mouse mammary tumors was studied as one possible factor underlying growth kinetics. The mouse's immunological system was either suppressed (thymectomy and whole-body x-irradiation) or stimulated (previous exposure to tumor cells) and the percent takes, latent period, and growth rates measured. There was no evidence for a strong antigenic factor in any of these tumors. A direct method (^{125}I-IUdR tracer) for measuring cell loss was developed. This method consists of injecting the mice with ^{125}I-IUdR and then measuring the loss of ^{125}I-activity from the tumor. This method has been used in tumors from three of the lines and the results correlate with cell loss as defined by the standard procedures. (CH)

29795 (CRSSA-BGE-73-2) IN-VITRO STUDIES OF THE REPAIR OF FRACTURED MAMMAL BONES EXPOSED TO IRRADIATION. Nguyen, T.-L.; Drouet, J.; Fournie, J.; Kraemer, M. (Centre de Recherches du Service de Sante des Armees, 92-Clamart (France). Div. de Biologie Generale et Ecologie). 1973. 53p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

The principal techniques used to maintain post-embryonic bone explants alive in cultures are presented. Up to a dose of 2,500 rads, there are no differences between the morphologies of irradiated and reference samples. In excess of 4,500 rads, a distinctly delayed response occurs with periosteal tissue. In addition, fibroblasts, elements of endosteal and medullar origin participate in repairing the fracture. When the dose reaches 10,000 rads, the first chondroblasts do not appear until the fifth day (24 hours with reference samples) in a much more abundant fundamental substance. (FR)

29796 (NP-19973) EFFECT OF IRRADIATION ON DELAYED HYPERSENSITIVITY AND ANTIBODY FORMATION IN RATS. Visakorpi, R. (Helsinki Univ. (Finland). Dept. of Serology and Bacteriology). 1973. 31p. Dep. NTIS (U. S. Sales Only) $3.75.

Thesis.

Whole-body x-irradiation of rats with a sublethal dose (800 rads) postponed the appearance of delayed skin reactivity to bovine serum albumin by about 5 to 6 days if the animals were irradiated 24 hours before, or up to 2 hours after immunization, and also partially suppressed them later on. The latent period in detectable production of humoral antibodies against BSA was prolonged. Lower radiation doses, which had only a very weak suppressive effect on delayed reactivity, prolonged the latent period in the humoral response to BSA. The appearance of paralysis in allergic

encephalomyelitis was postponed somewhat longer than that caused by similar doses in delayed hypersensitivity, but did not reach the level of suppression of the antibody response. If the animals were irradiated at a time when skin reactions could already be elicited, the capacity to react was suppressed for 4 to 5 days, but the skin then recovered the ability to react. When cell transfers were made during the induction phase, lymph node, thoracic duct, and spleen cells were able to restore delayed hypersensitivity in that order of effectiveness. For restoration of antibody response slightly larger doses of thoracic duct and lymph node cells were needed, but with spleen cells both responses were restored with the same minimum cell dose. Thymus cells showed a weaker restorative capacity and bone marrow cells were even less effective, especially in the case of delayed hypersensitivity. Cells from rats tolerant to bovine serum albumin did not restore the reactivity to BSA, but restored the ability to react to other antigens such as OT in skin tests, and to produce antibody against bacteriophage ϕX-174. (FI)

29797 (ORO-3547) ROLE AND UTILIZATION OF ERYTHROPOIETIN IN STIMULATING ERYTHROPOIESIS. Final Report. (Tennessee Univ., Knoxville (USA). Memorial Research Center and Hospital). 1973. Contract AT(40-1)-3547. 8p. Dep. NTIS $4.00.

Studies on the effects of radiation on erythropoietin in mice showed that if the mice were made hypoxic, the erythropoietin levels demonstrated a cyclic variation. When miniature pigs were x-irradiated the erythropoietin level closely followed the hematocrit level. Studies were also conducted on the effects of bone marrow transplants, polycythemia, 5-fluorouracil, globulins, vinblastine, and diethylstibestrol on erythropoiesis. Methods for extraction of erythropoietin-containing proteins from urine were developed. (HLW)

29798 (RT/BIO-(73)31) EFFECTS OF HIGH ENERGY RADIATION ON THE LENS IN MICE. Di Paola, M.; Bianchi, M.; Baarli, J. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 27 Nov 1973. 14p. (In Italian). (CONF-730587-1). Dep. NTIS (U.S. Sales Only) $4.00.

From meeting of the space biophysics work group of the council of Europe; Geneva, Switzerland (7 May 1973).

The effectiveness of ionizing radiation in the induction of lens opacities has been the subject of a number of investigations because of its importance to radiation protection and of its radiosensitivity at low doses. For radiation protection purposes near accelerators and in space the neutrons of high energy are particularly important, but no data have so far been reported for neutrons with energies above 14 MeV. The induction of lens opacification in mice exposed to the 400 MeV neutron beam from the CERN synchrocyclotron was studied. The estimation of the RBE was made in comparison to 250 kV x rays. (auth)

29799 CHANGES IN THE EXCITABILITY OF NERVE FIBRES UNDER IRRADIATION. Tscherpunov, S. A.; Tschepurnova, N. E. (Moscow State Univ.). pp 185-187 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971). (In German).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

It is shown that a trace increase of excitability and a periodical change in excitability "under the beam" takes place in nerves subjected to small doses of ionizing radiation. An attempt is made to explain the observed phenomena from the positions of the modern theory of primary processes. (auth)

29800 EXTRACHROMOSOMAL FACTORS IN SPONTANEOUS PULMONARY TUMORIGENESIS IN BALB/c/Cb/Se MICE. Squartini, F. (Univ., Pisa, Italy); Bolis, G. B. Lavori Ist. Anat. Istol. Patol., Univ. Studi Perugia; 33: 5-15(1973). (In Italian).

Various experiments were carried out with the aim to detect possible extrachromosomal factors involved in spontaneous lung tumorigenesis of BALB/c/Cb/Se mice. During three successive experiments lung tissue from newborn BALB/c mice was grafted subcutaneously into adult syngeneic recipients either panirradiated previously or untreated. Among the latter group of control mice some were thymectomized at birth. Alveolar adenomas were observed only in the lung grafts recovered from recipients panirradiated before grafting (χ^2 14.325; P < 0.001). This suggests that panirradiation activates a lung tumour agent in BALB/c mice. Lung tissue from newborn BALB/c mice was grafted subcutaneously into old syngeneic recipients of 16-20 months of age. Only rare grafts have taken and none has showed alveolar adenomas. Whole blood from old BALB/c mice of 16-20 months of age was injected intraperitoneally (0.2 ml.) into newborn recipients of the same strain. 56.2% of the recipients developed lymphatic leukaemia after a mean latency of 399 days. One of the leukaemic animals showed also multiple pulmonary adenomas at autopsy. (auth)

29801 VIRAL ETIOLOGY OF LEUKEMIA AND LYMPHOMAS IN MICE. A Brief Historical Survey and Present Status. Gross, L. (Veterans Administration Hospital, New York). Zentralbl. Bakteriol. Parasitenk., Abt. I; 220: 57-65(May 1972).

Studies on mouse leukemia are reviewed with regard to: experimental attempts to transmit leukemia in mice; transmission of mouse leukemia following inoculation of leukemic extracts into newborn mice; development of a highly potent strain of mouse leukemia; epidemiology; electron microscope studies of the mouse leukemia virus; and the viral nature of radioinduced leukemia. The isolation of a leukemogenic virus from radioinduced mouse leukemia and serial passage of this virus in newborn mice demonstrated for the first time the viral nature of leukemia and lymphomas induced by radiation. (HLW)

29802 COMPARISON OF NONSPECIFIC IMMUNITY INDEXES AND FORMATION OF C_x-REACTIVE PROTEIN ON NEUTRON AND X IRRADIATION. Shubik, V. M.; Katsnelt'son, G. M.; Sel'tser, V. K. (Scientific-Research Inst. of Radiation Hygiene, Leningrad). Zh. Mikrobiol., Epidemiol. Immunobiol.; No. 5, 105-110(May 1973). (In Russian).

Neutron and x irradiation decreased the lysozyme titer and increased the C_x-reactive protein in the blood serum of rabbits. Changes in the serological indexes depended on the dose and type of radiation. The lysozyme titer decreased following neutron irradiation at doses of 100 and 400 rads and x irradiation at doses of 400 rads. It was concluded that fast neutron irradiation decreases the nonspecific immunity (lysozyme titer) and inflammatory reactions (formation of C_x reactive protein) more than x irradiation. (tr-auth)

29803 MITIGATION OF SECONDARY DISEASE OF ALLOGENEIC MOUSE RADIATION CHIMERAS BY MODIFICATION OF THE INTESTINAL MICROFLORA. van Bekkum, D. W.; Roodenburg, J.; Heidt, P. J.; van der Waaij, D. J. Nat. Cancer Inst.; 52: No. 2, 401-404(Feb 1974).

Conventional CBA mice subjected to lethal whole-body irradiation and allogeneic bone-marrow transplantation developed delayed secondary disease, which caused 95% mortality within 100 days. Symptoms of secondary disease as well as mortality were virtually absent in similarly treated mice kept in the germ-free state or given a colonization-resistant (CR) flora. Conventionalization of these mice as early as 40 days after transplantation did not induce a significant degree of secondary disease except in 1 group of CR mice derived from conventional mice by antibiotic treatment. The acute form of secondary disease occurring after transplantation of allogeneic spleen cells was much less influenced by the gnotobiotic conditions, which confirmed the concept that the mortality was caused primarily by severe graft-versus-host reactions. The implications of these findings for the treatment of patients receiving bone-marrow grafts are discussed. (auth)

29804 X RADIATION AND SENSITIZED LYMPHOCYTE MIGRATION. Ruprecht, A.; Clark, G. M.; Goldner, M.; Poyton, H. G. (Univ. of Western Ontario, London). Radiology; 111: No. 1, 201-205(Apr 1974).

Sensitized adult rat spleen lymphocytes and macrophages were irradiated in vivo with 10, 50, 100, or 200 rads of 120 kVp x rays. The lymphocyte-macrophage migration inhibition test was used to determine alterations in mammalian cell function due to x irradiation. It was found that cell migration decreased as x radiation increased, but the ability of lymphocytes to recognize the antigen to which they had been sensitized was not abolished. (auth)

29805 CORRELATION OF DOSE RATE AND BIOLOGICAL EFFECT IN RAT LIVER CELLS RESULTING FROM X-RAY, ^{113m}In, AND ^{198}Au IRRADIATION. Witcofski, R. L.; Pizzarello, D. J.; Smith, E. M.; Everhart, H.; Gnau, T. R. (Bowman Gray School of Medicine, Winston-Salem, NC). J. Nucl. Med.; 15: No. 4, 241-245(Apr 1974).

The potential hazards from internally administered radionuclides used in nuclear medicine are usually compared with each other and with diagnostic x rays on the basis of the absorbed dose in rads with no regard to the dose rate of the radiation. Using the production of chromosomal aberrations (bridges) in rat liver cells as an endpoint for biological damage, we compared the effectiveness of irradiation when the same total dose was delivered rapidly with x ray or at lower dose rates with radioactive colloids of ^{113m}In or ^{198}Au. Because in the adult liver there is little cell division with associated loss of damaged cells, chromosomal aberrations are retained when irradiation is either rapid or protracted. However, when an urgent demand for cells occurs, such as after surgical removal of a major portion of the liver, the liver responds by undergoing rapid proliferation which reveals this chromosomal damage. In a range of dose between 125 and 1,000 rads, irradiation with x rays or ^{113m}In was approximately twice as effective as ^{198}Au in inducing

chromosomal bridges. The relationship of damage (bridges) to dose appears to be linear in each case and extrapolation to low doses suggests a similar time-dose effect, but direct proof of this is lacking. (auth)

29806 BIOFIZIKA I RADIOBIOLOGIYA, VYPUSK 3. (Biophysics and Radiobiology, Volume 3). Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). 120p.

Separate abstracts were prepared for the 16 papers presented in this publication. (ERB)

For abstracts of individual papers see: 29514, 29661, 29687, 29688, 29706, 29707, 29807–29815, and 31054.

29807 PEROXIDASE ACTIVITY OF HEMOGLOBIN AND INDIVIDUAL FRACTIONS THEREOF DURING X-RAY AND FAST-NEUTRON IRRADIATION OF ANIMALS. Shur'yan, I. M.; Starodub, N. F.; Rekun, G. M. pp 20-26 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

It was shown that during the acute period of radiation sickness (8th to 12th day) in rats there is a reliable increase in the peroxidase activity of whole Hb. The change in enzyme properties for individual Hb fractions obtained by column chromatography on aluminium oxide is not uniform. The greatest increase in peroxidase activity is found in the third and fourth fractions. Methemoglobin exhibits catalytic activity as peroxidase to a significantly greater degree than oxy-, carboxy-, and nitroxyhemoglobin. (JPRS)

29808 PEROXIDASE ACTIVITY OF THE BLOOD AND THE METHEMOGLOBIN CONTENT OF X-RAY AND FAST-NEUTRON IRRADIATED RATS. Shur'yan, I. M. pp 26-32 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

A study was made of peroxidase activity and methemoglobin content of rat blood in the dynamics of radiation sickness induced by exposure to x rays and fast neutrons. It was ascertained that the peroxidase activity of the blood of rats irradiated with x rays and fast neutrons in LD_{100} and LD_{50} doses increases sharply, reaching maximum values on the 12th to 16th day after irradiation. A significant increase in the methemoglobin content of the blood of irradiated animals is directly related to peroxidase activity. (JPRS)

29809 ACTIVITY OF POTASSIUM IONS IN FAST-NEUTRON IRRADIATED RAT BLOOD. Rudakov, N. P. pp 32-43 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

A study was made by means of ion-selective electrodes of the change in K^+ activity in the erythrocytes, plasma, and whole blood of rats exposed to whole-body fast-neutron irradiation in doses of 200 and 300 rads. During the post-irradiation period, a K^+ redistribution between erythrocytes and plasma, which has a phase character and is dependent on irradiation dose, takes place in the animals' blood. Potassium concentration in whole blood does not vary significantly in the course of radiation sickness, but increases appreciably during the period preceding an animal's death. (JPRS)

29810 REPAIR RATE OF RADIATION INJURIES IN RATS AND DISTURBANCE OF CERTAIN METABOLIC PROCESSES IN THE LIVER AFTER WHOLE-BODY AND LOCAL FAST-NEUTRON IRRADIATION. Rudakov, N. P.; Tatsii, Yu. A. pp 43-61 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

The rate of repair processes for radiation injuries in rats pre-exposed to whole-body or local fast-neutron irradiation was found to be approximately the same as gamma- and x irradiation. With both methods of irradiation, nonspecific changes were discovered in the animals' liver in tissue sorptive power, glycogen and lipid content, and alanine aminotransferase activity. An approximate estimate is given of the specific value of radiation injury in the total radiation reaction of the organism during neutron irradiation. (JPRS)

29811 VARIATION IN CHOLESTEROL CONTENT OF RAT LIVER DURING WHOLE-BODY AND LOCAL FAST-NEUTRON IRRADIATION. Tatsii, Yu. A. pp 61-67 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

Whole-body irradiation of rats in an $LD_{50/30}$ dose (215 rads) and local irradiation of the liver in doses of 300, 600, and 1500 rads result in an increase in the total amount of cholesterol in the liver and a delay in its esterification during the early post-irradiation periods. Local irradiation of the liver in a dose of 200 rads results in no appreciable changes in cholesterol metabolism. (JPRS)

29812 OXYGEN CONSUMPTION BY ANIMALS IN THE DYNAMICS OF FAST-NEUTRON-INDUCED RADIATION SICKNESS. Druzhina, N. A. pp 67-73 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

A study was made of oxygen consumption by rats and oxygen pressure (pO_2) in brain tissues during early periods of radiation sickness induced by fast neutrons (100, 215, and 300 rads). These indicators declined notably before the animals' death. (JPRS)

29813 ACTION OF FAST NEUTRONS ON FUNCTIONAL MORPHOLOGICAL STATE OF THE RAT THYROID. Antipov, I. V. pp 90-93 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

Experimental data are presented from which the reaction of the thyroid to fast neutrons can be judged. The functional activity of the thyroid decreased sharply the first few days after irradiation but then increased; by the twentieth day the gland was hyperfunctional, but returned to normal at the end of the month. Definite, but nonspecific morphological changes were seen. They are typical of the functional state of the gland, which may be explained by many other factors such as changes in the hypothalamus, pituitary, and adrenals. (tr-auth)

29814 NEOPLASM INDUCTION IN RAT MAMMARY GLANDS BY FAST NEUTRON IRRADIATION. Chebotarev, E. E.; Gerasimova, T. B. pp 93-98 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

The induction of neoplasms in mammary glands of rats by fast neutrons was studied. A single dose of 25, 50, 200, or 400 rads caused tumors in 16, 38, 33, and 60% of the animals, respectively. Histological examination showed the structures of fibroadenomas, adenomas, adenofibromas, cystomas, adenocarcinomas, solid tumors, and fibrosarcomas. (tr-auth)

29815 MECHANSIM OF BLASTOGENIC ACTION OF FAST NEUTRONS ON THE MAMMARY GLAND. Turkevich, N. M.; Chebotarev, E. E.; Akimova, R. N.; Gerasimova, T. B.; Samudzhan, E. M.; Khaetskii, I. K. pp 98-106 of Biofizika i Radiobiologiya, vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

The effect of neutron irradiation on the formation of tumors in the mammary gland was studied, and investigations were made to clarify the mechanism of the carcinogenic action of radiation. It was found that fast neutrons increased the luteotropic function of the pituitary, decreased the reactivity of the adrenal cortex, and changed the function of the sex glands. It may be hypothesized that disruption of the neuroendocrine regulatory system is one of the mechanisms in the carcinogenic action of fast neutrons on the mammary gland. (tr-auth)

29816 SEROLOGICAL AND PATHOMORPHOLOGICAL ASPECTS OF AUTOIMMUNIZATION IN EXPERIMENTALLY-INDUCED TUBERCULOSIS IN GUINEA PIGS EXPOSED TO FRACTIONATED γ IRRADIATION AND ISONIAZIDE TREATMENT. Vylchanov, V. Kh.; Vasilev, V. N.; Kekhaiov, I. R. Izv. Mikrobiol. Inst., Bulg. Akad. Nauk.; 23: 101-109(1972). (In Russian).

Studies were carried out to elucidate the role of small doses of γ rays (fractionated exposure) in the autoimmunization process in guinea pigs experimentally infected with Mycobacterium tuberculosis $H_{37}R_v$. The experiments involved 6 groups, each of 10 animals: group I infected by inoculation of 0.002 mg of M. tuberculosis and on the 28th day of the infection a treatment started with isoniazide in doses of 10 mg/kg daily in the course of 45 days. Four weeks after the infection whole body irradiation began in doses of 10 rad of γ rays, applied at 9-day intervals, a total of 6 irradiations. Group II—infected, irradiated, and untreated; group III—infected, irradiated and treated, the treatment being started after the third irradiation; group IV—infected, non-irradiated and treated; group V—infected only (non-irradiated and untreated); group VI—irradiated only (uninfected and untreated with isoniazide). The doses of infection and irradiation of the animals in group II, III, IV, V, and VI were similar to those in group I. The results of the serological and pathomorphological studies revealed the following: Higher frequency of complement-fixing and hemagglutinating autoantibodies to lung, brain and testis was found in the guinea-pigs experimentally infected with tuberculosis and subjected to fractionated irradiation in comparison with the non-irradiated infected animals. This indicates that the small doses of γ rays of the order of 10r while summed up are of significance for the aggravation of autoimmunization process induced during the experimental tuberculosis. The treatment with isoniazide decreased the frequency of induced autoantigenicity and the formation of tissue autoantibodies. (auth)

29817 INFLUENCE OF VARIATION OF THE DAILY RHYTHM OF EXPOSURE ON THE MAGNITUDE OF BIOLOGICAL EFFECTS: A COMPARISON OF X-RAY IRRADIATION AND CARBON DISULFIDE INTOXICATION. Wronska-Nofer, T.; Knobloch, K. (Inst.

of Occupational Medicine, Lodz, Poland). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 20: 813-819(1972).

The magnitude of biological effects of carbon disulfide and x rays when applying the same total exposure at varying rhythms was investigated. Two different ryhthms of exposure were applied: in the daily exposure rats were exposed to vapor of carbon disulfide (0.96 mg/l) for 2.5 h daily over 8 months or were irradiated with a dose of 50 R daily over 5 weeks and the exposure was kept in both cases for 6 consecutive days of each week; in the intermittent exposure rats were exposed to vapors of carbon disulfide (0.96 mg/l) for 5 h daily, over 8 months or were irradiated with dose of 100 R over 5 weeks and in both cases the exposure was kept for 3 consecutive days of each week, followed by 4 free of exposure days. The magnitude in biological effects of both factors was assessed based on the concentration of blood lipids, the rate of synthesis of cholesterol in liver and the excretion of N-methylnicotinamide in urine; additionally in x ray treated animals the total white cell count in the peripheral blood was considered. The magnitude of effects depended on the rhythm of exposure. The intermittent exposure involved deeper disturbances. No explanation of this fact can be offered yet. (auth)

29818 REGENERATION OF ANEUROGENIC LIMBS OF SALAMANDER LARVAE AFTER X IRRADIATION. Rose, F. C.; Rose, S. M. (Tulane Univ., New Orleans). Growth; 38: No. 1, 97-108 (Mar 1974).

A test was made to determine whether x rays prevent limb regeneration in Amblystoma larvae by interfering with the special activity of nerves. The main test was made on parabiosed larvae, one member of which had aneurogenic forelimbs. The other partner had normally innervated forelimbs. Innervated limbs and limbs that had never had nerves were x-rayed at the same time. They received 5000 R or 7000 R. The limbs with nerves did not regenerate after these dosages. Forty-two of 71 aneurogenic limbs regenerated after the x-irradiation. Of the 29 that did not regenerate, all but two had regressed before regeneration could be expected. (auth)

29819 PREVENTION OF RADIATION-INDUCED, EARLY, TRANSIENT INCAPACITATION OF MONKEYS BY AN ANTIHISTAMINE. Doyle, T. F.; Curran, C. R.; Turns, J. E. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Proc. Soc. Exp. Biol. Med.; 145: No. 3, 1018-1024(Mar 1974).

The antihistamine chlorpheniramine maleate is effective in preventing early transient incapacitation (ETI), postirradiation performance decrement, and in reducing the hypotension observed in monkeys after a 4000-rad dose of mixed gamma–neutron radiation. Since the major pharmacological effect of chlorpheniramine is blocking histamine receptor sites, its effectiveness in preventing or modifying the radiation-induced performance changes and hypotension can be taken as further evidence that histamine is involved in acute radiation syndrome. However, the ETI-ameliorating properties of chlorpheniramine are not mediated through the maintenance of arterial blood pressure. An earlier study in which similarity trained and irradiated monkeys were infused with norepinephrine so that blood pressure was maintained above 100 mm Hg did not show significant differences in performance from controls. Some mechanism other than deficient blood pressure, yet capable of being ameliorated by chlorpheniramine, is implicated in ETI. (auth)

29820 RAPID METHOD FOR THE DETERMINATION OF TUMOUR RBE. Begg, A. C.; Fowler, J. F. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Radiol.; 47: No. 554, 154-156(Feb 1974).

Brief note is made of a method of tumor assay in which results were obtained within 10 days of irradiation. Radioactive (20 μCi) iododeoxyuridine, (^{125}IUdR) was injected intraperitoneally into mice 4 to 5 hr before local irradiation of their tumors, and the rate of loss of radiation from the tumor measured in vivo daily for 10 days. The loss rate reflecting cell loss rates increased with increasing radiation dose given but only up to about 2,000 rads of x rays; RBE values for fast neutrons and 240 keV x rays were calculated by this method over a range 0 to 1000 rads and compared with several regrowth experiments in the same animals and concurrent experiments. It appeared that the activity loss method gave smaller error limits than the regrowth experiments. (UK)

29821 LATE VASCULAR EFFECTS OF RADIATION. Hopewell, J. W. (Churchill Hospital, Oxford). Brit. J. Radiol.; 47: No. 554, 157-158(Feb 1974).

Detailed examination has been made of the vessels in the brain of a rat dying 3 months after a single local exposure to 3000 R. There were indications that the irregularly spaced constrictions represented clones of endothelial cells stimulated into division as a result of cell loss occurring when radiation damaged cells attempted to divide. The accelerating effects of hypertension on latent vascular irradiation damage are explained in relation to the increase in turnover of endothelial cells caused by hypertension. (UK)

29822 EFFECTS OF X IRRADIATION ON GROWTH AND FUNCTION OF THE REPAIR BLASTEMA (GRANULATION TISSUE). 1. Wound Contraction. van den Brenk, H. A. S.; Orton, C.; Stone, M.; Kelly, H. (Saint Thomas' Hospital, London). Int. J. Radiat. Biol.; 25: No. 1, 1-19(Jan 1974).

Pre-operative local irradiation of intact rat skin given immediately before wounding caused dose-dependent reductions in the rate of wound contraction, largely by delaying and inhibiting growth of the repair blastema. When the dose was fractionated, evidence of recovery of sublethal damage [$(D_2 - D_1) \simeq 250$ rads] was obtained. The effect of pre-operative irradiation was decreased by increasing the time between irradiation and wounding. Pre-operative local irradiation of the skin, partly shielded by a lead grid or by a lattice of lead discs, with large single doses (4 to 8 kR), caused no reduction in the rate of wound contraction and showed that spatial discontinuity of blastemal tissues did not prevent integration of function. Partial shielding of the margin or base of a freshly-made wound during irradiation showed that the sphincter-like concentration of blastema produced at the periphery of an open wound principally effected contraction. When the radiation was given postoperatively to a contracting wound (i.e., after the repair blastema had developed) the rate of contraction was not decreased. The bearing of the radiobiological findings on the mechanism of wound contraction and their relevance to combined treatment by radiotherapy and surgery was discussed. (auth)

29823 EFFECTS OF X RAYS ON THE RESPONSES OF PORCINE LYMPHOCYTES TO THE MITOGENIC STIMULUS OF CONCANAVALIN A IN VITRO. Vaughan-Smith, S.; Ling, N. R. (Univ. of Birmingham, Eng.). Int. J. Radiat. Biol.; 25: No. 1, 73-85 (Jan 1974).

The proliferative response of porcine lymphocytes in vitro was studied after x irradiation at various times before stimulation with concanavalin A (con A). The percentage of cells able to enter DNA synthesis was reduced as the radiation dose and/or the time between irradiation and stimulation was increased. The degree of impairment of response was independent of the con A dose used for stimulation, and the binding of con A to lymphocytes was not significantly altered by irradiation. The magnitude of the loss of the response could be reduced by incubating the irradiated lymphocytes at 4°C instead of 37°C before stimulation. Fractionated radiation-dose experiments indicated that unstimulated lymphocytes are unable to repair potentially lethal damage between irradiations, as judged by their subsequent ability to enter DNA synthesis. Repair of radiation damage, if it occurs, is probably initiated after activation. (auth)

29824 OXYGEN ENHANCEMENT RATIO AND RELATIVE BIOLOGICAL EFFECTIVENESS FOR COMBINED IRRADIATIONS OF CHINESE HAMSTER CELLS BY NEUTRONS AND γ RAYS. Railton, R.; Porter, D.; Lawson, R. C.; Hannan, W. J. (Western Regional Hospital Board, Glasgow). Int. J. Radiat. Biol.; 25: No. 2, 121-127(Feb 1974).

The loss of reproductive capacity of Chinese hamster cells was studied using ^{60}Co γ rays and DT neutrons to provide different fractions of the total dose. Survival data were obtained for aerobic and hypoxic cells and rbe and oer values determined at the 10% survival level. The rbe with respect to ^{60}Co γ rays was found to vary linearly with the γ-ray percentage of the total dose, whereas the oer variation was more complex. The implications of these results are discussed with reference to neutron radiotherapy. (auth)

29825 RADIOSENSITIVITY OF RESTING AND PROLIFERATING MOUSE-LIVER CELLS FOR MITOTIC DELAY AND THE INHIBITION OF DNA SYNTHESIS. Coggle, J. E. (Saint Bartholomew's Hospital, London). Int. J. Radiat. Biol.; 25: No. 2, 197-203 (Feb 1974).

Groups of 75 mice were given 450 rads whole-body 250 kVp x rays either 4 hr before, 12 hr after, or 32 hr after partial hepatectomy i.e., when most of the liver cells were in the G_0 phase, G phase, and S phase respectively. All groups showed a delay in the onset of division and a reduction in total mitotic activity. Similar groups of 75 were given the same radiation dose at the same time-points after surgery, then killed in groups of 15, 1 hr before which they were given intraperitoneally 1 μCi g^{-1} body-weight of tritiated thymidine. All irradiated groups showed a marked delay in the onset of ^{3}H-labeling, none having occurred 36 hr after operation. The irradiated groups also showed a marked reduction in the total number of cells undergoing DNA synthesis, with the exception of cells irradiated when they were regenerating and in DNA synthesis i.e., about 32 hr after partial hepatectomy. (UK)

29826 VARIATIONS IN $LD_{50/30}$ IN A STRAIN OF RATS OVER 20 YEARS. Udupa, K. B.; Warren, S.; Chute, R. N. (New England Deaconess Hospital, Boston). Health Phys.; 26: No. 4, 319-322 (Apr 1974).

The $LD_{50/30}$ was determined periodically for NEDH rats, male and female, from 1953 to 1973, ranging from 710 to 905 R. The mean was 801 R. There was no significant seasonal variation. The general health of the colony was an important factor. The advent of infection reduces somewhat the $LD_{50/30}$ while long-term exposure of the colony to infection increases this dose level slightly and gives some protection against hematopoietic damage. (auth)

29827 EFFECT OF WHOLE-BODY X IRRADIATION AND OF 2,4,6-TRIETHYLENIMINO-1,3,5-TRIAZINE ON THE MOUSE KIDNEY: INDUCTION OF A DEOXYRIBONUCLEASE. I. Tempel, K. (Univ., Munich). Zentralbl. Veterinaermed., Reihe A; 20: No. 6, 487-497(Aug 1973). (In German).

The in-vitro activity of the deoxyribonuclease I increases in mouse kidney homogenates after whole-body irradiation (140 to 1,120 R) or after intravenous injection of 2,4,6-triethyleniminos-triazine (TEM) (0.8 to 4.0 mg/kg body weight), the increase being dose-dependent up to maximal values of more than 200% of the normal on the fourth day. The DNase I reaction is dose-dependently inhibited or suppressed when the animals are given i.v. Actinomycin D or cycloheximide in doses of 0.05 to 0.5 and 1.0 to 4.0 mg/kg body weight, respectively, 24 and 48 hrs after the beginning of the experiment. Analogous changes occurred after subsequent irradiation or treatment of the animals with doses of 70 to 30 R or up to 0.2 mg TEM/kg body weight. The DNase I reaction increased to a maximum of 100% when the mice were given intravenously doses of DNA of ≤ 25 or 50 mg/kg, at once or 24 or 48 hrs after having received whole-body irradiation or after administration of TEM. These results confirm earlier studies on the rat and they characterize the rise in activity of DNase I in the mouse kidney and under the influence of irradiation of biological alkylants as enzyme induction. The mechanism of induction and the biological significance of the reaction remain for further study. (auth)

29828 SUPPRESSION OF ERYTHROPOIESIS BY SIMULTANEOUS PROLIFERATION OF ALLOANTIGEN-SENSITIVE UNITS. Kitamura, Y.; Kawata, T.; Kanamuru, A.; Seki, M. Exp. Hematol.; 1: 350-361(1973).

Parental (CBA-T6T6) cells are injected into (DS × CBA-T6T6) F_1 hybrid mice following varying doses of irradiation. Proliferation of erythropoietic cells was assayed by ^{59}Fe uptake in the spleen and that of alloantigen-sensitive units (AASU) by 5-iodo-2'-deoxyuridine-^{125}I uptake. Erythropoietic differentiation of parental bone marrow cells was suppressed when the cells were injected with parental lymph node cells, and there were inverse relationships between the proliferation of erythroid cells and that of AASU. The change in the erythropoietic microenvironment seemed to have a more important role than the humoral erythropoiesis stimulating factor, because the erythropoiesis remained suppressed when the mouse was joined in parabiosis with another mouse in which erythropoesis was not as suppressed. With regard to the change in the local environment, the activating process of AASU was essential, not the activated AASU per se or some secretion of activated AASU. Evidence favoring this interpretation is:
1) Re-irradiation (830 rads) of the host abolished the suppressive effect of the previously injected, activated lymph node cells.
2) Erythropoietic differentiation of the marrow cells mixed with activated AASU was not suppressed when the cells were injected into irradiated CBA-T6T6 mice. (auth)

29829 RADIOSENSITIVE STAGES OF THE RAT INCISOR ODONTOBLAST AS DEMONSTRATED BY AUTORADIOGRAPHY. Stroemme Koppang, H. (Univ., Oslo). Scand. J. Dent. Res.; 81: 303-314(1973).

Five Cl ^3H-glycine/g body weight were administered to six rats 30 min prior to, and to six rats 24 h after, exposure to a single head roentgen dose of 500 R. Autoradiographic investigations of the incisors demonstrated that the most radiosensitive cells, the preodontoblasts just prior to dentin production, proceeded to mantle dentin deposition while the cells were partially deprived of their capacity of circumpulpal dentin production. Slightly less sensitive were mantle dentin-producing cells, the injury to which was also reflected as a partial lack of circumpulpal dentin production. The radiosensitive period (500 R) was approximately equivalent to a maximum of 48 h, and a minimum of 24 h. (auth)

29830 REGENERATION OF THE MICE LIVER AFTER FRACTIONATED ROENTGEN AND PROTON IRRADIATION. Yarmonenko, S. P.; Shmakova, N. L.; Fadeeva, T. A.; Bulatova, G. V.; Vainson, A. A.; Vainberg, M. Sh. (Inst. of Experimental and Clinical Oncology, Moscow). Med. Radiol.; 19: No. 3, 47-51 (Mar 1974). (In Russian).

The authors studied the rate of regeneration of the locally irradiated liver of mice in different conditions of dose fractionation. Regeneration was induced by a partial hepatectomy, conducted on the 4th day upon the termination of irradiation. Increment in wet and dry weight served as the criteria of intensity of regeneration. Slowing down of the regeneration tempo in the dose range of 1570 to 3140 rad is linearly changed from 31 to 47% (by dry weight). Two tested irradiation conditions (fine fractionation—137 rad 4 times a week and large fractionation—550 rad once a week which had been carried out in the course of 3 to 6 weeks before obtaining cumulative doses (1650 and 3300 rad) caused similar suppression of regeneration) in 20 to 25% in the first case and 34 to 36% in the second one. The rate of regeneration after roentgen and proton irradiation carried out in strictly the same depth distribution of the absorbed dose in equivalent cumulative doses (3300 rad of roentgen and 4125 rad of proton irradiation, RBE coefficient 0.8, once a week in the course of 6 weeks) was suppressed to a similar degree. (auth)

29831 CHANGE OF OXYPROLINE-CONTAINING COMPOUNDS IN PLASMA AND URINE AFTER IRRADIATION. Nesterova, V. I.; Davydova, S. A.; Poluboyarinova, Z. I.; Vodyakova, L. M. Med. Radiol.; 19: No. 3, 51-56(Mar 1974). (In Russian).

The authors studied the changes of protein-bound oxyproline level in the plasma and total oxyproline of the urine in acute radiation sickness in mice (dose of γ irradiation is 800 and 950 R) with local β irradiation (dose—5000 rad). In cases of acute radiation sickness the authors found the increase of oxyproline excretion on the 4th and 5th days after irradiation. In burns due to β-irradiation the increase of excretion was observed earlier (the second day) and was followed by a considerable lowering of the oxyproline level in the urine during the period of erosive-ulcerous affection of the skin. The revealed changes can testify to the increase of collagen catabolism in radiation injury of the tissue in a relatively early period with further inhibition of the synthetic reparative processes. (auth)

29832 EFFECT OF DRIED THYROID GLAND PRETREATMENT UPON ERYTHROPOIETIC ACTIVITY AND DEVELOPMENT OF ANAEMIA IN SUBLETHALLY X-IRRADIATED MICE. Popisil, M.; Netikova, J.; Pipalova, I. (Inst. of Biophysics, Brno). Folia Biol. (Prague); 20: No. 1, 59-67(1974).

The possibility of a favorable effect of thyroid hormone pretreatment on postirradiation recovery of erythropoiesis was tested in mice, using ^{59}Fe uptake, newly formed erythrocyte release and red blood cell count as criteria. The results show that 21-day peroral administration of dried thyroid gland in a dose of 0.6 mg. per 100 g. diet stimulated erythropoiesis, in particular, extramedullary, and led to an increase in erythrocyte count in peripheral blood. Postirradiation erythropoietic recovery of mice exposed to a whole-body dose of 450R was markedly stimulated by thyroid gland pretreatment. This favorable effect was reflected also in a milder degree of postirradiation anemia. The effect can be explained by persisting higher level of red blood cell count and by activation of erythropoiesis in auxiliary blood-forming organs. (auth)

Invertebrates

Refer also to abstract 29922.

29833 INDUCTION OF MINUTE MUTATIONS IN DROSOPHILA BY X RAYS. Ondrej, M. (Inst. of Experimental Botany, Prague). Folia Biol. (Prague); 20: No. 1, 14-19(1974).

Minute mutations were induced in Drosophila melanogaster wild stock Suchumi by x rays and the kinetics of their incidence was followed throughout gametogenesis. Spermatogenesis was much more sensitive to the induction of Minute mutations than oogenesis. All broods of spermatogenesis, like all broods of oogenesis, showed approximately similar frequencies of Minutes. The dose response was approximately exponential. Most of the Minutes found in F_1 were transmissible to F_2. The results of our experiments are in good agreement with Fahmys' hypothesis of interference of macromolecules with normal DNA synthesis. (auth)

29834 EVOLUTION IN THE PERCENTAGE MORTALITY OF BOMBYX MORI AFTER IRRADIATION IN THE LARVA STAGE WITH X RADIATION. Coulon, M. (Lyon Univ., Villeurbanne, France). Compt. Rend., Ser. D; 227: No. 16, 1683-1686(22 Oct 1973). (In French).

The results obtained after the irradiation of 2nd, 3rd, and 4th stage larva are presented, the radiosensitivity being expressed by the percentages of mortality and of permanent larva. (FR)

29835 RADIOSENSITIZATION OF DROSOPHILA SPERM BY COMMONLY USED FOOD ADDITIVES. Butylated Hydroxyanisole and Butylated Hydroxytoluene. Prasad, O.; Kamra, O. P. (Dal-

housie Univ., Halifax, Nova Scotia). Int. J. Radiat. Biol.; 25: No. 1, 67-72(Jan 1974).

The radiosensitivity of sperm of Drosophila melanogaster was enhanced by a factor of about two by commonly used food additives. Neither butylated hydroxyanisole (BHA) nor butylated hydroxytoluene (BHT), with and without gamma irradiation (0, 1.2, 2.4, and 3.6 krads), had any noticeable effect on sex-ratio. At the concentration used (0.001% BHA; 0.001% BHT), the two phenolic antioxidants seem to induce X^0-chromosome loss in the sperm (XO males in F_1) and sex-linked recessive lethal mutations in F_2, although these effects were not statistically significant. However, both agents proved to be potent radiosensitizers for the sex-linked recessive lethals. (auth)

29836 POSITIONAL INFORMATION AND PATTERN REGULATION IN HYDRA: THE EFFECT OF γ RADIATION. Hicklin, J.; Wolpert, L. (Middlesex Hospital, London). J. Embryol. Exp. Morphol.; 30: No. 3, 741-752(Dec 1973).

Hydra exposed to high doses of γ irradiation (25000 rad) are still capable of regeneration although no normal mitotic figures could be seen for up to 48 h after irradiation. Irradiated heads could still inhibit head formation in other regions in graft combinations. The time for head end determination in irradiated animals appeared to be increased. It is concluded that head end regeneration need not involve cell division. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 29342, 29713, 29775, and 29903.

29837 (BNWL-SA-4864) USE OF FISSION PRODUCT NUCLEAR DATA IN LIFE SCIENCES. Alpen, E. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. 5p. (CONF-731133-2). Dep. NTIS $3.00.

From meeting on fission product nuclear data; Bologna, Italy (26 Nov 1973).

Applications of fission product nuclear data and data on the fission process in uranium and transuranic elements are required for radiation protection of personnel and the general population for the following situations: to determine the toxicity to exposed individuals from externally located isotopes in the environment or in the fuel cycle; to determine the toxicity caused by deposition of radioactive materials in living systems; to estimate the radiation dose to patients during medical application of injected radioisotopes for diagnostic or therapeutic means; during the use of sealed sources for implantation in living tissue (brachytherapy); during the use of sealed sources at a distance from the patient for therapeutic purposes (teletherapy); to determine the environmental pathways for uncontrolled release of radioactive materials into biosphere; and for personnel protection during the applications of radioisotopes in medicine, biology, agriculture, and industry, including γ ray and neutron radiography. It was concluded that available nuclear data are adequate for these purposes. (CH)

29838 (FDA-73-8029, pp 71-78) RADIATION DOSES FROM NUCLEAR MEDICINE PROCEDURES. Cloutier, R. J.; Watson, E. E. (Oak Ridge Associated Universities, Inc., TN). Mar 1973.

In health physics in the healing arts.

Although the risks to an individual patient from a specific diagnostic radiopharmaceutical may be negligible, it is important to know the actual radiation dose to the patient so that a true balance of risks versus benefits may be made. It is also important to know how the individual's radiation dose contributes to the total population dose so that the public health aspects of nuclear medicine can be properly evaluated. The method most frequently used today for calculating the radiation dose to a patient from a radiopharmaceutical is that presented by the Society of Nuclear Medicine's Medical Internal Radiation Dose (MIRD) Committee. The basic equation is: $\bar{D}_{(t\leftarrow s)} = (\tilde{A}_s/m_t) \Sigma \Delta_i \phi_{i(t\leftarrow s)}$ where $\bar{D}$ is the average dose to a target organ, t, when the activity is located in a source organ, s. The remaining terms used in the equation and methods used to calculate the absorbed fraction of penetrating radiation are discussed. Data on the absorbed fraction for 25 targets and 16 source organs are given in MIRD Pamphlet 5, based on computer calculations using a standard-man phantom. The radiation dose a patient receives is directly proportional to $\tilde{A}_S$ which is called the cumulated activity in the source organ. $\tilde{A}_S$ has units of microcurie-hours and is equivalent to the total number of decays that occur in the source organ. To obtain $\tilde{A}_S$ one takes the time integral of activity in the source organ. Since the actual retention curve is a function of the radioactive half-life and the biological half-time of the material in the body, $\tilde{A}_S$ depends on these values. In 1969 the Swedish National Institute of Radiological Protection issued a compilation of dose estimates based on a critical survey of the literature. The ICRP has also studied the problem of the absorbed dose from radiopharmaceuticals and has issued ICRP Publication 17, "Protection of the Patient in Radionuclide Investigation." Publication 17 provides the dose to standard man and some information on how different routes of administration may change the patient's dose and also how the dose may vary with age. Hine and Johnston prepared a convenient table that gives the range of internal radiation doses to the total body and various organs from the administration of radionuclides. The MIRD Committee plans to issue a series of pamphlets, each dealing with a specific radiopharmaceutical. The pamphlets will include compilations of biological and physical data necessary for dose calculations as well as the dose. (33 references) (CH)

29839 (FDA-73-8029, pp 141) GENERALIZED COMPARTMENT MODEL WITH AN APPLICATION TO DOSE FROM IRON-55 AND IRON-59. Bernard, S. R.; Snyder, W. S. (Oak Ridge National Lab., TN). Mar 1973.

In health physics in the healing arts.

29840 (FDA-73-8029, pp 146) DOSE TO THE BLADDER WALL FROM A RADIONUCLIDE EXCRETED THROUGH THE URINE. Snyder, W. S. (Oak Ridge National Lab., TN). Mar 1973.

In health physics in the healing arts.

29841 (FDA-73-8029, pp 605-611) DOSE REDUCTION IN THYROID UPTAKE TESTS WITH I-125. Sayeg, J. A.; Preston, D. F. (Univ. of Kentucky, Lexington). Mar 1973.

In health physics in the healing arts.

29842 FIVE YEARS OF THE WORK OF THE URANIUM INDUSTRY HEALTH CENTRE RADIOTOXICOLOGICAL UNIT. Vich, Z. (Zavodni Ustav Narodniho Zdravi Uranoveho Prumyslu, Pribram, Czech.). Sb. Ved. Odbornych Pr., Zavodni Ustav Narodniho Zadravi Uranoveho Prum., Pribram; 5: 7-8(1970). (In Czech).

A brief outline is given of the work of the Uranium Industry Health Centre Radiotoxicological Unit over the five years of its existence up to November 1970. The Unit's scientific accomplishments were reported on in 43 professional articles, in 43 papers presented at conferences and congresses, in 66 lectures given to the personnel of the Centre itself, and in 9 progress reports on research projects. One invention was patented. Other institutions participated in the scientific work of the Unit, namely, the Institute of Occupational Hygiene of the Uranium Industry, specialized departments of the Uranium Industry Health Centre, and specialized medical centres of various enterprises. (INIS)

29843 EARLY RESULTS OF ^{123}I THERAPY OF THYROTOXIC GRAVES' DISEASE. Siemsen, J. K.; Wallack, M. S.; Martin, R. B.; Nicoloff, J. T. (Univ. of Southern California, Los Angeles). J. Nucl. Med.; 15: No. 4, 257-260(Apr 1974).

In an attempt to reduce the high incidence of hypothyroidism following radioiodine treatment of Graves' disease, ^{123}I was used instead of ^{131}I. The low-energy emissions of ^{123}I theoretically deliver less radiation to the nucleus of the thyroid cell than to its hormone-generating apex. Sixty patients were treated with an estimated delivered high dose of 200 μCi/gm and forty with a low dose of 100 μCi/gm. After more than 12 months followup, 71% of the high-dose group were euthyroid, 24% still hyperthyroid but half of these substantially improved, and 5% hypothyroid. The low-dose treatment was a failure since 53% of the patients remained toxic. It is concluded that ^{123}I in the dose range of 200 μCi/gm is effective in controlling Graves' disease. Subsequent followup will reveal whether its use will reduce the incidence of late hypothyroidism. (auth)

29844 PRACTICAL ASPECTS OF EXPOSURE CONTROL. Milligan, V. M. (Reynolds Electric and Engineering Co., Inc., Las Vegas, NV). pp 1187-1197 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

The obvious exposure control consideration is the amount of external or internal radiation dose allowed personnel under established limits, but the health physicist who implements exposure control procedures faces other problems, the solutions to which may unjustifiably increase operational costs, and prevent completion of a particular operation. Workable solutions to these problems seldom originate at the desk of an administrator, but are found by the consciencious health physicist who works closely and cooperatively with operational personnel. Dose reports are a valuable tool for control of accumulated dose. The maximum benefit insofar as dose control is concerned centers around the

problems of data retrieval. Warehouses full of dusty and unused records, except in the relatively rare instances of law suits years after the fact, are useless to the operational health physicist. More effort, therefore, should be expended to extract from exposure records statistical information relative to exposure trends, frequency of occurrence of particular radionuclides, etc., to aid the health physicist in pinpointing potential problem areas and in pre-planning. (auth)

29845 SOME OBSERVATIONS OBTAINED FROM A NATION-WIDE IN VIVO COUNTING SERVICE. Hegelson, G. L.; Pollard, D. E. (Helgeson Nuclear Services, Inc., Pleasanton, CA). pp 1235-1255 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York, Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

Since most radioisotopes encountered in the nuclear industry are insoluble, in vivo counting provides one of the best methods for determining internal burdens of many radioisotopes. This paper discusses findings from approximately 7000 counts during the first three years of a nation-wide mobile in vivo counting service. ^{60}Co the most frequently observed contaminant, will probably contribute the most lung exposure. Its effective half-life is generally about one to two years. ^{65}Zn is present in people working at reactors where Admiralty Metal is used. It tends to mask other nuclides such as ^{60}Co and causes other operational problems such as high dose rates from waste containers. Using an 8 × 0.5 inch NaI(Tl) detector in a shadow shield whole-body counter the authors have been successful in routinely measuring as low as 20% of the maximum permissible lung burden (MPLB) of ^{235}U in a 40 minute count. If the true lung burden is 0.245 mg of ^{235}U, one MPLB at 93% enrichment, the probability is 90% that in any one measurement the observed activity will be 0.245 ± 0.088 mg. Most industries have an excellent safety record, however, a few have significant internal dose problems. The in vivo records have proven very useful in discovering trends in plant contamination status, boosting sagging employee morale, and in proving to regulatory agencies that the latest techniques are used for estimating internal dose. (auth)

Animals

Refer also to abstract 29805.

29846 (BNWL-SA-4789) BIOLOGICAL EFFECTS OF DAILY INHALATION OF RADON AND ITS SHORT-LIVED DAUGHTERS IN EXPERIMENTAL ANIMALS. Palmer, R. F.; Stuart, B. O.; Filipy, R. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1972. Contract AT(45-1)-1830. 26p. (CONF-730915-14). Dep. NTIS $3.50.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

Exposures of rats, mice, and hamsters for 90 hours per week to radon daughters ranging from 2000 to 8500 WL, with and without 18 μg per liter uranium ore dust, caused marked life-shortening in all three species. Marked reduction in body weights occurred in all three species, with weight losses of 30 to 50% of control animal values in all species after 3½ months of exposures. Mice exposed to radon daughters and ore dust were particularly susceptible in terms of mortality, although the lungs of these animals showed very little pathological change. Classical radiation pneumonitis with alveolar septal fibrosis and occasional bronchiolar epithelial hyperplasia were the predominant deep lung lesions seen in all species. In contrast to hamsters exposed 30 hours per week to 1200 WL of radon daughters and uranium ore dust, proportionately more of the pathology was seen in the upper respiratory tracts of the hamsters in the present study. The contrast between markedly affected trachea and major bronchi vs. relatively little effects in deep lung was most evident in rats. Findings of severe suppurative laryngitis and bronchitis were frequent in rats, and may have been an important contributing factor to their death. These findings dictate further studies involving sacrifice and radioactivity analyses of tracheal and lung tissues to determine relative absorbed radiation doses at these sites for correlation with developing degenerative and proliferation changes of the respiratory tract in each species. (auth)

29847 (UR-3490-348) BIOLOGICAL EFFECTS OF RADON ON THE LUNG. Morken, D. A. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 22p. (CONF-730915-13). Dep. NTIS $3.25.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

The biological effects of radon on the lung arise primarily from the alpha decay of the short-lived decay products of radon inhaled. Radon is chemically inert and so is distributed throughout the body according to its solubility in the various body tissues. The daughter products are isotopes of polonium, bismuth, and lead and are treated individually by the tissues and fluids, within the confines of their brief half-lives. Experiments with inhaled decay products indicate the dose to lung is much greater than to the rest of the body. Extensive injury was done to the bronchial tree, but the lesions did lead to bronchial tumors, and after irradiation ceased, these lesions were quickly repaired. Permanent changes, but no cancer, were seen in the region of the respiratory bronchioles. Compared to other alpha emitters in the lung, the alpha radiation from radon is particularly inefficient in producing radiation-specific tumors. The conclusion is taken that the radiation effects of alpha emitters may be inconsequential compared to chemical effects of the alpha emitters. (auth)

Microorganisms

29848 INDUCTION OF LETHALITY AND DNA BREAKAGE BY THE DECAY OF IODINE-125 IN BACTERIOPHAGE T4. Krisch, R. E.; Ley, R. D. (Argonne National Lab., Ill.). Int. J. Radiat. Biol.; 25: No. 1, 21-30(Jan 1974).

Iodine-125 was incorporated into the DNA of coliphage T4 in the form of 5-iododeoxyuridine (IUdR), an analogue of thymidine. ^{125}I decays by electron capture with consequent vacancy cascades and multiple ionization (Auger effect). This decay mode is known to cause extensive fragmentation of labeled small molecules. ^{125}I-labeled T4 phage were stored in a glycerol-casamine acid storage medium at −196°C during decay and assayed for the induction of lethalities and double-strand breaks (DSB's) in DNA. The lethal efficiency per decay σ(lethal), is 0.59 ± 0.08, in reasonable agreement with the previously determined value for ^{125}I decay in T1 phage, σ(lethal) = 0.49 ± 0.03. The efficiency of induction of DSB's, as determined by sedimentation of extracted DNA in neutral sucrose gradients, is 1.01 ± 0.13. These results indicate that every decay causes a DSB, but that some DSB's are non-lethal. σ(DSB) is independent of storage temperature during decay (+4°C versus −196°C) and is also independent of whether storage is as intact phage or as free DNA. This suggests that the observed DNA breakage is due to local ^{125}I decay effects, rather than to the ionizing radiation emitted during decay. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstracts 29308, 29371, 29372, 29380, 29385, and 30193.

29849 (BNWL-1850(Pt. 2), pp 123-124) IRON-55 IN HUMAN POPULATIONS OF THE WORLD. Jan 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological sciences.

Marine organisms have been shown to have up to 1000-fold higher specific activities of ^{55}Fe than that in seawater. It was also shown that ^{55}Fe specific activities increase 10 to 30-fold in salmon between mid and northern altitudes. These observations are currently explained on the basis of a different chemical form for fresh ^{55}Fe in seawater and greater dilution of the ^{55}Fe by stable iron at the mid-latitudes than at the northern latitudes. The half-time for ^{55}Fe concentrations in mature harvested salmon at all latitudes is approximately 10 months, which is comparable to the half-time for the movement of stratospheric debris to the earth's surface. (auth)

29850 DISTRIBUTION AND INCORPORATION OF TRITIUM IN THE ORGANS OF RUMINANTS. Kirchmann, R. (CEN, Mol, Belgium); Remy, J.; Charles, P.; Koch, G.; van den Hoek, J. pp 385-402 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

A research program on the transfer of tritium in the food chain has been in progress for several years on the experimental farm of the Nuclear Energy Research Centre at Mol. Besides the contamination of grass and fodder by tritiated water and the incorporation of tritium into milk constituents, the distribution of tritium in the organs of ruminants contaminated in various ways has been investigated. A cow was sacrificed 23 days after ingestion of 250 mCi of tritiated water in a single dose; three young male calves ingested 1 mCi of tritiated water daily for 25, 33 and 40 days respectively and were then sacrificed; three other calves ingested tritiated milk; a calf whose mother had received about 11 mCi THO per day for 40 days during gestation

received mother's milk for 3½ months and was then sacrificed; finally, a pregnant goat was given water containing 46.6 μCi of ^{3}H/litre and the three kids were sacrificed at birth, at the age of one month and two months, respectively. The various organs were removed and analyzed for the content of ^{3}H in the tissue water and in the organic matter. Some DNA was prepared by the conventional method from the thymi, testicles and liver of young ruminants (calves and kids). The presence of ^{3}H was detected in the purified DNA. However, since there was a possibility of contamination of the DNA by traces of amino acids, the DNA was precipitated in a CsCl medium. Radioactivity was present in the peaks of DNA prepared from the thymi and testicles of a calf which had received 1 mCi THO/d since birth, and from the testicles of a calf which had ingested tritiated powdered milk daily (15 μCi/d). Deeper fractionation of the cell constituents of certain organs (thymi, testicles and liver) indicates the degree of incorporation of ^{3}H into lipids, RNA, proteins and DNA. (auth)

Man

Refer also to abstracts 29329, 29346, 29370, 29375, 29382, 29775, 29778, 29917, 29929, 31374, 31550, and 31572.

29851 (AEC-tr-7481) IODINE METABOLISM IN CHILDREN AND ADOLESCENTS IN AN AREA OF THE COMMUNITY. Karhausen, L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Mar 1973. Translation of EUR-4864. 140p. Dep. NTIS $5.45.

A European model of thyroid function during growth was established in order to draw conclusions with regard to radiation protection. Kinetic studies involving iodine-131 and iodine-125 were carried out on 46 infants and 47 adolescents. A three-compartment model is presented for age groups from 0 to 6 months, six months to one year, one to two years and for adolescents and adults. The ICRP diameters were calculated for the various age groups. Tables are presented to show thyroid uptake of iodine and urinary content in normal children and adolescents of various ages. (HLW)

29852 (SSI-1974-4) CESIUM-137 IN A CONTROL GROUP AT THE NATIONAL INSTITUTE OF RADIATION PROTECTION, 1973. Falk, R.; Eklund, G. (Statens Seruminstitut, Copenhagen (Denmark)). Jan 1974. 6p. (In Swedish). Dep. NTIS (U.S. Sales Only) $4.00.

The amounts of cesium-137 in a control group of around 20 persons employed at the National Institute of Radiation Protection in Sweden have been measured. A whole-body measuring technique was used. Results of measurements performed from 1966 to 1973 are given. (KK) (Sweden)

29853 INFLUENCE OF PERCHLORATE ON RADIOIODINE ELIMINATION FROM THE BODY. Simonovic, I.; Popovic, S.; Latkovic, I.; Krpan, N. (Univ., Zagreb). Arh. Hig. Rada Toksikol.; 23: No. 4, 277-292(1972). (In Slovene).

Iodine-131 belongs to the group of fission products which endanger man following nuclear explosions and reactor accidents. On the basis of the theoretical and experimental considerations of the kinetics of iodine metabolism it seems most efficient to prevent ^{131}I uptake by the thyroid. With this in view we gave euthyroid persons pharmacological doses of perchlorate and studied the effect of perchlorate on the capability of the thyroid to accumulate iodine, the rate of its uptake, the constancy of the effect of repeated doses, the duration of the thyroid block, and the influence of perchlorate on body retention and elimination of radioiodine. (auth)

29854 IN VIVO DETERMINATION OF ^{90}Sr BY ANALYZING BREMSSTRAHLUNG FROM THE SKULL. Olson, D. G. (Atomic Energy Commission, Idaho Falls, ID). pp 689-709 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

A method is described for the direct in vivo determination of ^{90}Sr by measuring the bremsstrahlung. Less than 0.02 of a maximum permissible body burden can be detected in a 10-min. count. Because the skull constitutes a major part of the skeleton covered only by a thin layer of tissue, the detector is placed alongside the head to obtain maximum sensitivity. In addition, this configuration minimizes the interference from radioactive contamination in the trunk of the body, particularly in the lungs, muscle, and gastrointestinal tract. Even though the contribution from contamination is minimized, the bremsstrahlung region of the spectrum is adjusted for even small quantities of gamma emitters by concurrently counting counting the whole-body and the skull to determine quantitative correction factors. Bremsstrahlung spectra from over 150 humans with normal quantities of in vivo radioactivity are used to ascertain the counts required to correct for background. The system was calibrated by inserting 100 capsules of $^{90}Sr-^{90}Y$ in the skeleton of a Rando phantom on a proportional weight basis. Three levels of activity covering the range from 1 to 8 μCi were measured to obtain a detection efficiency of 1100 ± 33 c/m/μCi of ^{90}Sr in the 40–120 keV energy region. The prime advantages offered by the technique are that information is available within minutes and, compared to bioassay, the cost per analysis is markedly reduced. (auth)

29855 FLUCTUATIONS OF DAILY EXCRETION OF PLUTONIUM AND THEIR INTERPRETATION FOR ESTIMATION OF THE BODY BURDEN. Snyder, W. S.; Ford, M. R.; Muir, J. R.; Warner, G. G. (Oak Ridge National Lab., TN). pp 711-722 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The question is considered of how one can distinguish a high level in urine due to a new intake from a high level that is merely a result of the day-to-day fluctuations of urinary excretion. Equations are developed to describe relationships between intake and excretion. The probability is examined of the additional excretion due to an intake being significantly high in the sense that inequality is satisfied and this is examined as a function of the sampling time. (HLW)

29856 RESPIRATORY TRACT DEPOSITION OF URANIUM IN OCCUPATIONALLY EXPOSED PERSONNEL. George, A.; Wing, J. F.; Baird, R. (Atomic Energy Commission, New York). pp 743-757 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

In a brief field evaluation of a new technique for measuring uranium intake in occupationally exposed individuals, the uranium deposited by inhalation in four subjects in a three-day period was excreted almost entirely within two weeks, 95% by fecal elimination. The rapid, nearly total fecal clearance was consistent with upper respiratory deposition of insoluble dust, the airborne uranium having been U_3O_8 with an aerodynamic median diameter of about 10 microns. Reasonable agreement between measurements of intake and excretion tend to validate the intake data which were obtained by the technique of monitoring individual exposures by lapel samples and of periodic measurement of fractional respiratory deposition using a special breathing apparatus. (auth)

29857 ADMINISTRATION OF AN IN-VIVO COUNTING PROGRAM. Kalmon, B. (Goodyear Atomic Corp., Piketon, OH). pp 759-771 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The administration of an in-vivo counting program as applied to insoluble uranium compounds with the lung as the critical organ is described. Criteria for restricting work activities and for removal from work restrictions as well as derivation of the lung burden and the weight of ^{235}U equivalent to one lung burden are presented. Methods of in-vivo computation and sample calculations for both a single positive in-vivo result and a series of positive in-vivo results are included. (auth)

29858 CALCULATION OF EXPECTED URINARY AND FECAL EXCRETION PATTERNS USING THE ICRP TASK GROUP ON THE HUMAN RESPIRATORY TRACT. Voilleque, P. G. (Atomic Energy Commission, Idaho Falls, ID). pp 773-808 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Determination of the body burden of and prediction of the dose to an individual who accidentally inhales a predominantly alpha-or-beta-emitting radionuclide frequently rests on the interpretation of excretion data. In order to relate the excretion data to the actual inhalation, the report of the Task Group on Lung Dynamics for Committee II of the International Commission on Radiological Protection (ICRP) was used as the basis for the derivation of equations for the calculation of the urinary and fecal excretion patterns expected subsequent to an acute inhalation exposure to a radioac-

tive aerosol. Because rapid interpretation of excretion data is often desirable, a computer code was developed which simplifies the application of the equations. The predicted excretion patterns are compared with excretion data from accidental human exposure cases. The effects of particle size and chemical state of the inhaled aerosol are examined, and the implications for in-plant air sampling and incident documentation are discussed. (auth)

29859 COMPARISON OF THE RESPIRATORY DEPOSITION OF AIRBORNE RADIOACTIVITY AS DETERMINED BY GRADED FILTRATION TECHNIQUE AND THE CURRENT ICRP LUNG MODEL. Shleien, B. (National Center for Radiological Health, Winchester, MA). pp 1159-1169 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

Data are presented on the particle size of airborne ^{95}Zr-^{95}Nb, ^{131}I, ^{89}Sr, and ^{90}Sr collected at ground-level following two atmospheric nuclear detonations. The particle size and respiratory deposition results obtained by graded filtration technique are compared to ICRP Lung Model data for Activity Median Aerodynamic Diameter (AMAD) versus deposition. In the pulmonary region, for particle sizes between 0.15 to 3.0 microns in diameter, results are in agreement. For particles above 3.0 micron, estimated pulmonary deposition ranged from 10 to 17 percent and 3 to 17 percent, respectively, for the ICRP and the experimental data. Comparisons are also presented for deposition of airborne radioactive particles in the nasopharyngeal region of the respiratory tract. It is concluded that the graded filtration techniques yields results similar to those predicted by the ICRP Lung Model of Activity Median Aerodynamic Diameter versus deposition. (auth)

29860 EMERGENCY MONITORING OF AN INHALATION INCIDENT. Ziemer, P. L.; Landolt, R. R. (Purdue Univ., Lafayette, IN). pp 1455-1479 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Accidental rupture of a sealed quartz ampule containing approximately 1 curie of Europium oxide (^{152}Eu, ^{154}Eu, ^{155}Eu, and ^{156}Eu mixture) resulted in the generation of aerosol which caused significant external and internal contamination of two individuals. Health physics emergency procedures were initiated within five minutes of the incident and will be summarized in detail. This includes the initial evaluation and response to the accident report; the preliminary evaluation of personnel and area contamination; and the immediate exposure control methods. Subsequent medical handling and problems will be reviewed. Decontamination methods, equipment, and materials will be summarized together with economical considerations used in evaluating the clean-up program. Aspects of reporting of the incident by news media and the handling of publicity will be given. (auth)

29861 PLUTONIUM-AMERICIUM CONTAMINATION ASPECTS OF A DRY BOX INVOLVING HAND AMPUTATION. Brodsky, A.; Wald, N.; Lee, R. E.; Horm, J.; Caldwell, R. (Univ. of Pittsburgh). pp 1601-1620 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

An employee whose hand was amputated at the wrist by a milling machine in a dry box accident was brought to Presbyterian-University Hospital. About an hour after he arrived, his contaminated hand was brought to the hospital and assessed for contamination. Initial counting of the hand indicated high levels of Pu-Am contamination, which influenced the medical decision regarding rejoining the hand. Several hours after the patient was brought to the hospital, the hand and the stump had been debrided and decontaminated, but there were still hundreds of times the maximum permissible body burden (based on bone) of Pu-Am on the hand. However, it was deemed unlikely that very much of the contamination would enter the blood stream during the anastomosis of blood vessels and grafting of skin. Thus, the hand was reattached, but reamputated 3 days later when gangrene of the fingers occurred. Further evaluation of the patient showed that a negligible amount of radioactivity remained on the suture of the stump, the remaining activity on the stump was removed with the removal of the remaining scabs, and no measurable internal burden remained after several weeks. Details of the emergency management are reported, together with measurements of the distribution of the remaining contamination on the skin of the hand. (auth)

29862 PROMPT HANDLING OF CASES INVOLVING ACCIDENTAL EXPOSURE TO PLUTONIUM. Held, K. R.; Jech, J. J. (Battelle Pacific Northwest Labs., Richland, WA). pp 1621-1639 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Accidents involving exposure, or potential for exposure, to plutonium require prompt analysis and action by trained radiation protection and medical personnel to facilitate rapid evaluation of the seriousness of the exposure and possible therapeutic treatment to minimize ultimate deposition within the body. Procedures used at Hanford to screen, evaluate, and report accidents are briefly described. The types of data collected to aid in these evaluations are discussed. The effectiveness of these procedures based on the experience of approximately 2000 plutonium workers over a 23-year span is reviewed. Studies in progress to improve capabilities for initiating prompt mitigatory action are briefly discussed. (auth)

Animals

Refer also to abstracts 29304, 29381, 29388, 29921, and 29949.

29863 (AEC-tr-7523) RADIOBIOLOGY AND RADIOECOLOGY OF FARM ANIMALS. Annenkov, B. N.; Dibobes, I. K.; Aleksakhin, R. M. (eds.). 1973. Translation of Radiobiologiya i radioekologiya sel'skokhozyaistvennykh zhivotnykh, Atomizdat, Moscow, 1973. 221p. Dep. NTIS $7.60.

Problems of the migration of the most important artificial radionuclides in the biological chain of fodder-farm animals are reviewed. The metabolism of radionuclides in the bodies of farm animals and the effect of external irradiation and incorporated radionuclides on these animals are examined. The results of extensive experimental studies conducted in the USSR and abroad are summarized in the work. In addition to their theoretical interest, the data presented are of practical value in developing measures for reducing the conversion of radioactive substances into livestock and agricultural products. The book is intended for radiobiologists, radioecologists, livestock breeders, veterinarians, hygienists, and graduate students and upperclassmen at agricultural institutes. The book has 107 tables, 33 figures, and 395 bibliographic entries. (auth)

29864 (CEA-CONF-2466) STUDY OF EXCHANGEABLE RADIOSTRONTIUM IN RATS. Coexistence of Two Groups of Bone Forms: Diffusible and Nondiffusible. Maillard, M. J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1973. 19p. (In French). (CONF-730989-2). Dep. NTIS (U. S. Sales Only) $4.00.

From international colloquium on the physical chemistry and crystallography of apatites of biological interest; Paris, France (10 Sep 1973).

The release of exchangeable bone ^{85}Sr complexes in rats varies with time, their specific nature, their mobility, and the different places where they are fixed. The shape of the curve expressing the fecal elimination/urinary elimination ratio as a function of time is related to the existence of soluble and insoluble complexes. The increased fecal elimination following a decreased urinary elimination becomes more apparent when the formation of amorphous phosphate is more probable than that of the crystalline form. This abnormal fecal clearance can be explained in terms of the rejection of an excess of the amorphous form. (FR)

29865 (CEA-CONF-2542) STUDY OF THE TRANSLOCATION OF RADIOSTRONTIUM FROM WOUNDS AND THERAPY BY LOCAL INSOLUBILIZATION. Ducousso, R.; Causse, A.; Pasquier, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 4p. (CONF-730907-20). Dep. NTIS (U. S. Sales Only) $3.00.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

The translocation of ^{85}Sr was followed by external counting of the wound and homologous bone during two-hour period and by measurement of the blood radioactivity following uptake from two types of wounds simulated on Maccacus monkeys: puncture wounds and lacerations. The same experimental procedure was applied in order to test therapy using rhodizonate (K), $MgSO_4$, alginate (Ca), or aluminium phosphate gel for the removal of Sr from laceration wounds either 5 or 15 min after the contamination. It was verified that local or intravenous administration of DTPA did not result in an increased absorption of Sr. (auth)

29866 EXCRETION OF ^{42}K FROM THE TISSUES OF ORGANS OF IRRADIATED ANIMALS. Drozd, S. S.; Burlakova, E. V.;

Burdin, K. S. (Moscow State Univ.). Biol. Nauki; No. 3, 56-59 (Mar 1973). (In Russian).

The kinetics of distribution of ^{42}K in the liver, muscle, and brain of irradiated and nonirradiated mice was studied with liquid scintillation counting of tissue homogenates and urine. The ^{42}K accumulated especially rapidly in the liver and more slowly in the brain. Animals irradiated with doses of 720 and 1000 R showed a sharp decrease in the ^{42}K content in the tissues studied. The isotope was excreted 23 to 25 hr after irradiation with a dose of 720 R and 2.5 to 3 hr after irradiation with 1000 R. (tr-auth)

29867 ACCUMULATION OF TRITIUM IN VARIOUS SPECIES OF FISH REARED IN TRITIATED WATER. Patzer, R. G.; Moghissi, A. A.; McNelis, D. N. (National Environmental Research Center, Las Vegas, NV). pp 403-412 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

The release of tritium into aquatic ecosystems has resulted from nuclear industry operations. Because of the projected expansion of the nuclear power industry and associated fuel reprocessing plants, such releases can be expected to increase and to require further assessment of the environmental impact. Considerable information exists for the behavior and fate of tritiated water in mammals; however, few experimental data are available on the incorporation of tritium from tritiated water into fresh water fishes. Of particular interest are fish that begin and end their lives in a tritiated environment. In the present study trout and channel catfish eggs were hatched and the fish maintained in tritiated water for four months. In addition, two species of minnows native to the southwest United States of America were maintained in tritiated water and offspring from these fish were reared in tritiated water for five months. Some of these native fish were maintained for two months in large outdoor pools in which part of their food was grown naturally. The tritium concentrations in aquaria water were held constant during the experimental period. The results show that for these species of fish living in tritiated water the concentration factor for organic bound tritium is generally less than unity. The concentration factor is defined as the specific activity of tritium in dried body tissue divided by that in the water in which the fish were reared. Literature concerning the behavior of tritium in aquatic food chains after release in nuclear industry effluents is reviewed. (auth)

29868 MOVEMENT OF PLUTONIUM AND AMERICIUM FROM WOUND SITES. Watters, R. L.; Johnson, L. J. (Colorado State Univ., Fort Collins). AT(11-1)-1787. pp 723-730 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

A study of contaminated wounds in beagle dogs has shown a difference in the rate of movement of plutonium relative to americium from the wound site. This indicates that the in vivo whole body determination of plutonium by the measurement of the americium 60-KeV gamma ray may lead to estimates of the plutonium body burden that are too low. A time study of the buildup of plutonium and americium in the lymph node that drains the wound site disclosed that the lymphatic system provides a rapid transport from the wound. This evidence indicates that rapid surgical excision, to be highly effective, should be performed as soon as possible. The conditions under which the experiments were performed were designed to simulate the industrial wound as closely as possible. Air oxidized plutonium collected from a process location was used for the implants. The effect of the therapeutic agent DTPA was studied. (auth)

29869 EVALUATION OF INTERNALLY DEPOSITED ^{241}Am FROM BIOASSAY DATA. Henle, R. C.; Bramson, P. E. (Battelle Pacific Northwest Labs., Richland, WA). AT(45-1)-1830. pp 731-741 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Evaluation of inhaled insoluble americium is readily accomplished by lung counting with scintillation counters. However, when soluble forms of americium are involved or the mode of intake is other than inhalation, bioassay samples are of value in determining the systemic internal deposition of americium. The available data on human and animal retention and excretion of americium indicates that the total excretion (urinary plus fecal) ratio of americium to plutonium is close to 1.0. The equation: $D_{eol} = 130\ (U + F)t^{0.94}$, comparable to the one derived by Langham therefore is appropriate for early estimates of initially soluble americium deposition. For an initially insoluble americium intake the Healy model of the form: $Q_0 = 500\ E_u 1\lambda_0^{B-\lambda t}(R-t)^{-0.74}\ dt$, utilizing only urine excretion rate is applicable for early estimates of deposition. (auth)

29870 BINDING CAPACITY OF SKELETAL MUSCLE CONSTITUENTS FOR CESIUM-134. Szentkuti, L.; Giese, W. (Tieraerztliche Hochschule, Hanover). Health Phys.; 26: No. 4, 343-347(Apr 1974).

Results obtained in studies on the ability to bind ^{134}Cs ions of muscle homogenates, different muscle proteins, and some subcellular muscle cell fractions are reported. In three different types of in-vitro experiments, the affinity of ^{134}Cs to muscle constituents was tested. The addition of increasing quantities of lyophilized homogenates of pork or beef to a ^{134}Cs-tris-buffer solution and subsequent centrifugation resulted in a decrease of the ^{134}Cs concentration in the supernatant. Lyophilized pork and beef virtually free from potassium and sodium only bound 1.74×10^{-12} moles Cs/g and 1.23×10^{-12} moles Cs/g, respectively. In equilibrium dialysis experiments with several cell constituents only tendinous tissue from beef muscle turned out to bind 3 to 6×10^{-10} moles Cs/g of lyophilized sample representing a 100 times greater affinity to ^{134}Cs than the entire muscle homogenate. This effect was not statistically significant. The washout of ^{134}Cs from muscle homogenates of rats was equally effective for muscles contaminated with ^{134}Cs in-vivo as well as in-vitro. Repeated elutions of radiocesium from muscle homogenates caused an exponential decrease of the ^{134}Cs content. The existence of at least two exponentials in the mathematical function describing the ^{134}Cs decrease indicated at least two different compartments of ^{134}Cs in the muscle. One of them retained ^{134}Cs more effectively than the other. The very small binding capacity of muscle homogenates for ^{134}Cs does not explain the high in-vivo accumulation of cesium isotopes in the skeletal muscle. (auth)

29871 TURNOVER OF ZINC-65 IN OYSTERS. Cutshall, N. (Oregon State Univ., Corvallis). Health Phys.; 26: No. 4, 327-331(Apr 1974).

The uptake and loss of ^{65}Zn by Pacific oysters are fitted by solutions to a first-order, linear differential equation that describes single-compartment isotope substitution kinetics. The rate constants for loss are related to the rate constants for uptake and to steady-state concentration factors for stable zinc and ^{65}Zn. The single-compartment solutions adequately fit uptake and loss data from field experiments extended as long as several hundred days. The rate constant estimated from loss data is 5.49×10^{-3} d^{-1} and that from uptake data is 4.93×10^{-3} d^{-1}. The apparent importance of multiple compartments can be affected in experiments where uptake times are short. (auth)

29872 DISTRIBUTION AND REMOVAL BY DTPA OF INJECTED ^{252}Cf IN THE RAT. Morin, M.; Nenot, J. C.; Iafuma, J. (CEN, Fontenay-aux-Roses, France). Health Phys.; 26: No. 4, 323-326(Apr 1974).

The distribution of ^{252}Cf administered intramuscularly to rats as nitrate at pH 1.5, 0.2 to 0.4 μCi per rat, was studied for comparison with that of other transplutonium elements. There was rapid bone deposition, representing 15% of the injected dose (ID) 1 day after the contamination and 25.5% ID 8 days later. DTPA treatment was successful even when started 3 weeks after ^{252}Cf injection; when DTPA treatment was begun 24 hr after ^{252}Cf, by 2 months, the urinary excretion was increased from 38.5 to 71.4% ID, contamination of the leg decreased from 10.9 to 2.2% ID, and the bone burden too was reduced from 26.0 to 6.5% ID. (auth)

New Tracer Techniques

Refer also to abstracts 28996, 29042, 29133, 29189, 29373, 29425, 29427, 29650, 29670, 29713, 29838, 29840, and 29841.

29873 (CONF-720699-P1) PROCEEDINGS OF 14th COLLOQUIUM ON NUCLEAR MEDICINE, TOURS, FRANCE, JUNE 9-10, 1972. Volume 1. (Centre Hospitalier Regional Bretonneau, 37 - Tours (France). Service d'Explorations Fonctionnelles par les Methodes Physiques). 1972. 125p. (In French).

Separate abstracts were prepared for the eight papers included that discuss various radioisotope tracer techniques for the evaluation of thyroid function and pathology. (CH)

For abstracts of individual papers see: 29874-29881.

29874 (CONF-720699-P1, pp 27-39) METHODOLOGY OF THYROID EXPLORATION BY IN VITRO RADIOISOTOPIC

METHODS. Beckers, C. (Univ., Louvain, Belg.). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The principal stages of thyroid metabolism of iodine are briefly reviewed. The principles, techniques, indications, and limitations of seven in vitro tests for thyroid pathology are outlined. The tests discussed are T_3 transfer, radioimmunoassay determination of thyroxine and of the triiodothyronine of the serum, measurement of the free fraction of circulating thyroid hormones, determination of the thyreostimuline of the serum, detection of the circulating iodoproteins, and detection of antithyroid antibodies. (JSR)

29875 (CONF-720699-P1, pp 41-50) RADIOIMMUNOLOGICAL DETERMINATION OF SERUM TRIIODOTHYRONINE. Brunelle, P. (Centre Henri Becquerel, Rouen); Bohuon, C.; Drouet, J.; Nouel, J. P. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A method for the radioimmunoassay of serum triiodothyronine without preliminary extraction is described. Antibodies are produced in the rabbit after injection of triiodothyronine coupled with human albumin. The antibody, after extraction from the rabbit, is reacted with ^{125}I-triiodothyronine of high specific activity. At equilibrium the antigen-antibody complex is precipitated by a second antibody-antiglobulin from the rabbit. The specificity, sensitivity, and precision of the method are discussed. The normal values are presented as a function of age and sex. (tr-auth)

29876 (CONF-720699-P1, pp 51-61) STUDY OF THE FIXATION OF SERUM TRIIODOTHYRONINE BY ALBUMIN MICROSPHERES IN THE FRAMEWORK OF THE STUDY OF THE THYROID FUNCTION. Rolleri, E.; Buzzigolli, G.; Plassio, G. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A T_3 radioimmunoassay test using serum albumin microspheres as a reversible adsorbant is described. The standardization of the method and the technique is discussed. The clinical results from 241 human serum samples from different physiopathological conditions of the thyroid are presented and a correlation is established with respect to other diagnostic tests of thyroid function. The method seems to respond perfectly to the needs of a T_3 test for precision, discrimination capacity, simplicity, and rapidity. (tr-auth)

29877 (CONF-720699-P1, pp 67-82) RELATIVE INDICATIONS OF IN VIVO AND IN VITRO TEST FOR THE EXPLORATION OF THE THYROID FUNCTION. Tubiana, M.; Fragu, P.; Bazin, J. P. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

Advantages and disadvantages of radioisotope tracer in vivo and in vitro tests of thyroid function are briefly summarized. The comparative value of these two types of tests is discussed. A possible sequence of tests for the diagnosis of hyperthyroidism and hypothyroidism is outlined. (JSR)

29878 (CONF-720699-P1, pp 83-89) STATISTIC STUDY OF THE RESULTS OF T_3-T_4 TESTS. Comparison with Data of the Braking Test. Besnard, J. C.; de Rycke, G.; Floyrac, G.; Planiol, T. (Centre Hospitalier Regional Bretonneau, Tours, France). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A statistical study of the T_3-T_4 tests was made on 1100 cases. The mean values and the limits are calculated and the types of statistical distribution are made precise for each of the two tests. The comparative study of the T_3, T_4, and braking tests was made on 66 cases. As a result of this comparison an attempt was made to define the limits of the Werner test. (tr-auth)

29879 (CONF-720699-P1, pp 93-97) DETERMINATION OF SERUM TRIIODOTHYRONINE IN THYROID PATHOLOGY. Nouel, J. P.; Brunelle, P.; Chaumant, J.; Bohuon, C. (Centre Henri Becquerel, Rouen). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The results of the determination of serum triiodothyronine by a radioimmunological method are compared with other more common methods for detection of thyroid malfunction. The results obtained from the various tests agree in general. In this preliminary study however the determination of serum triiodothyronine is shown to be superior to the determination of the index of free thyroxine. (JSR)

29880 (CONF-720699-P1, pp 103-113) CURRENT INDICATIONS OF THYROID SCINTIGRAPHY. Tauxe, N. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

Conditions warranting the use of thyroid scintigraphy are discussed. These include the identification of ectopic thyroid glands of congenital origin, traumatism, and inflammatory, degenerative, and autoimmunological illnesses. Typical ^{131}I scintigraphs obtained for each condition are shown. (JSR)

29881 (CONF-720699-P1, pp 115-121) CRITICAL STUDY OF SCINTIGRAPHY IN THYROID PATHOLOGY. Guinet, P.; Biere, J. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The technique and isotopes used in thyroid scintigraphy are briefly outlined. The scintigraphic picture for various malfunctions and pathology of the thyroid is described. (JSR)

29882 (CONF-720699-P2) PROCEEDINGS OF 14th COLLOQUIUM ON NUCLEAR MEDICINE, TOURS, FRANCE, JUNE 9-10, 1972. Volume 2. (Centre Hospitalier Regional Bretonneau, 37 - Tours (France). Service d'Explorations Fonctionnelles par les Methodes Physiques). 1972. 174p. (In French).

Separate abstracts were prepared for 18 papers included that discuss radioisotope scanning techniques for the evaluation of cardiovascular diseases. (CH)

For abstracts of individual papers see: 29425, and 29883-29899.

29883 (CONF-720699-P2, pp 146-164) SCINTIGRAPHY IN CARDIOLOGY. Planiol, T. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A review is given of the advances made in the use of scintigraphy in the dynamic and morphological study of the heart. The scintigraphic delimitation of cardiac morphology and the compartments of the cardiac blood pool are briefly described. The scintigraphic study of the myocardium is discussed in some detail. (JSR)

29884 (CONF-720699-P2, pp 166-172) MYOCARDIAC SCINTIGRAPHY AFTER INTRA-CORONARY INJECTION OF ^{99m}Tc-SERUM ALBUMIN MICROSPHERES. Weller, [D. A.] (Univ. of Cincinnati); Adolph, [R. J.]; Wellman, [H. N.]; Caroli, [R. C.]; Kim, [O.]. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The results of animal and human studies of the use of ^{99m}Tc-serum albumin microspheres in myocardium scintigraphy are reported. Laboratory and clinical evaluations were made of the toxicity of the radiopharmaceutical. The results showed that myocardium scintigraphy after injection of labeled serum albumin microspheres at the moment of coronary angiography is without danger and furnishes useful data on the presence, site, and dimensions of infarct and ischemia areas. (JSR)

29885 (CONF-720699-P2, pp 174-182) SCINTIGRAPHY IN CARDIOLOGY INTERVENTION. Carr, E. A.; Maseri, A.; Brochier, M. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

Typical myocardium scintigraphs obtained with the use of ^{131}Cs are shown. The disadvantages of this isotope led to the study of ^{131}I-labeled toluidine blue as the tracer in myocardium studies. Preliminary results obtained with dogs are reported Typical myocardiac scintigraphs obtained with the use of ^{99m}Tc-^{113}In-labeled serum albumin microspheres are shown. The clinical significance of myocardium scintigraphy in the location of infarcts and the early detection of aneurisms is discussed. (JSR)

29886 (CONF-720699-P2, pp 184-211) CARDIAC OUTPUT AND RADIOCARDIOGRAPHY. de Vernejoul, P. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A bibliographic review is given of the development of radioisotopic techniques for the measurement of cardiac blood output, cardiac morphology, and the quantitative study of the dilution of a radioactive tracer. The interpretation of data from a dilution curve is discussed. The scintigraphic techniques used in the measurement of cardiac output are outlined. The validity of the results obtained is discussed in some detail. (165 references) (JSR)

29887 (CONF-720699-P2, pp 212-218) ON-LINE TRANSMISSION OF ANALOG DATA BY A VECTOR USING THE REGION OF AUDIOFREQUENCIES. Particular Application to Radiocardiography. Barritault, L.; Prieur, G.; Sejourne, C.; Foucher, M.; Agnely, J.; de Vernejoul, P. (CEA, Orsay, France). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The on-line transmission of analog data obtained from radioisotope scintiscanning by a vector using audiofrequencies facilitates functional explorations in man. The case of radioisotopic dilution curves in the evaluation of blow flow in the heart is cited. A prototype using an ordinary telephonic vector, the Hertzian vector, and the common magnetic band is presented. The solutions kept for the conception of the emission part and the reception part are described. The limitations for the use of the apparatus are given. The extreme flexibility in the use of the apparatus in the hospital is stressed. (tr-auth)

29888 (CONF-720699-P2, pp 220-221) AUTOMATIC DETERMINATION OF CARDIAC OUTPUT. Burguet, W. (Univ., Liege); Merchie, G.; Champarnaud, J. D.; Hagliund, M. E. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

An automatic ^{131}I scintigraphic method for the determination of cardiac blood output is described. The radiocardiographic curve is obtained by the use of a punched tape connected with a computer coupled with a memory device and a visualization unit. This method makes it possible to obtain data on cardiac output and different parameters dependent on it in a very brief time. (tr-auth)

29889 (CONF-720699-P2, pp 222-228) AUTOMATION OF THE RADIOISOTOPIC MEASUREMENT OF CARDIAC OUTPUT AT THE BED OF THE PATIENT. Mehier, H.; Gubert, A.; Guey, A.; Heyden, D.; Barbe, R. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A portable device for the recording and processing of data necessary for the measurement of cardiac output by radioisotope scanning is described. The data transmitted by the detectors are registered digitally on a minicassette magnetic tape. The taped data is fed into a memory device operating in multiscale on a time base varying from 0.01 to 10 sec. The data show on a TV monitor the desired part of the curve and the processing of the corresponding data is done by a small computer that assures the smoothing of the curve, summation of the activity between two time limits, measurement of the activity in ppM on any number of channels, measurement of time elapsed between two chosen channels, extrapolation to infinite time of any part of the curve, and automatic calculation of the blood output and volume. (tr-auth)

29890 (CONF-720699-P2, pp 230-232) CALCULATION OF CARDIAC OUTPUT. Mounier, Y.; Guelfi, J.; Melki, G.; Herry, J. Y.; Houy, J. C. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A method is given for radioisotope scintiscanning for the calculation of the cardiac blood output. It substitutes for the exponential function of the drainage of a cardiac cavity a second-type Euler function calculated by approximation from 28 experimental points. It is much more rigorous than other methods. It can be applied to two successive peaks of the right and left cavity. (tr-auth)

29891 (CONF-720699-P2, pp 234-239) VALIDITY OF THE METHOD OF MEASUREMENT OF THE MYOCARDIAC OUTPUT BY XENON-133 IN DOGS: APPLICATION TO THE STUDY OF THE EFFICIENCY OF THE IMPLANTATION OF THE INTERNAL MAMMARY ARTERY IN THE CORRECTION OF CORONARY-INDUCED ISCHEMIA. Serres, P.; Guiraud, R.; Danet, B.; Boccardo, H.; Puel, P. (Service d'Explorations Fonctionnelles par les Radioisotopes, Toulouse). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

An experimental protocol was developed to study the validity of scintiscanning for the measurement of heart blood output using ^{133}Xe. The experimental study was made in dogs and the protocol was applied to the study of revascularization following the implantation of the internal mammary artery by the Vineberg technique. The protocol is described. The results showed that the technique of output measurement based on the Xe clearance gives an excellent picture of the actual output. The technique showed the location of the area revascularized by the Vineberg method. (JSR)

29892 (CONF-720699-P2, pp 240-244) CARDIAC OUTPUT AND RADIOCARDIOGRAPHY: INTERVENTION. Kriss, J. P. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The results of a study of the forms of myocardiac perfusions distributed dynamically and the quantitative estimations of the blood flow in various parts of the myocardium using ^{99m}Tc or ^{43}K are reported and compared with the results obtained from simultaneous radiographic contrast studies of the coronary arteries. In most cases there is an excellent correlation between the two methods. The types of cases in which there is a significant difference between the radiographic and radioisotopic methods are tabulated. (JSR)

29893 (CONF-720699-P2, pp 245-250) CARDIAC OUTPUT AND RADIOCARDIOGRAPHY: INTERVENTION. Baltaxe, H. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The results obtained with ^{133}Xe in the study of cardiac blood output using a small crystal scintillation detector are reported for three groups of subjects: those with normal veins, those having minimum lesions, and those with severe lesions. The difficulties encountered in the study of the regional output are described. (JSR)

29894 (CONF-720699-P2, pp 250-259) CARDIAC OUTPUT AND RADIOCARDIOGRAPHY: INTERVENTION. Cannon, J. (Columbia Univ., New York). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A new method using ^{133}Xe was developed for the quantitative evaluation of the capillary blood output in multiple regions of the myocardium simultaneously with coronary arteriograph. Typical data obtained with this method are given and discussed. The limitations of the method are considered. (JSR)

29895 (CONF-720699-P2, pp 260-264) CARDIAC OUTPUT AND RADIOCARDIOGRAPHY: INTERVENTION. Maseri, A. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

In order to measure the regional blood output a γ camera was connected with a computer so that the initial distribution of the tracer and its change under different physiological or pathological conditions could be seen and the washout rate in different zones determined. Xenon-133 was used as the tracer. The results obtained for different pathological conditions are illustrated. (JSR)

29896 (CONF-720699-P2, pp 264-269) CARDIAC OUTPUT AND RADIOCARDIOGRAPHY: INTERVENTION. Vacheron, A. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

Clinical results of radioisotopic measurements of coronary output and its comparison with pulmonary blood pressure measurements are reported. The radioisotopes used were ^{42}K and ^{113m}In. The coronary output was also measured during myocardium infarct. (JSR)

29897 (CONF-720699-P2, pp 270-284) GAMMA ANGIOCARDIOGRAPHY. Floyrac, R. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The use of scintillation γ cameras has extended the scope of exploration of cardio-pulmonary hemodynamics by adding direct visualization of the passage of the radioactive tracer to the quantitative data. The method used for data processing is described. The range and limitations of the use of ^{131}I, ^{137m}Ba, ^{99m}Tc, ^{113m}In, and ^{133}Xe are discussed. The applications of this technique are discussed from the qualitative and quantitative point of view. (JSR)

29898 (CONF-720699-P2, pp 286-287) SCINTIGRAPHIC TECHNIQUE USING A COMPUTER FOR THE REALIZATION OF DYNAMIC STUDIES OF THE LEFT AND RIGHT CARDIAC CAVITIES. Davies, H.; Kirch, D. L.; Steele, P. P.; Van Dyck, D. C. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A scintigraphic method for the visualization of blood flow through the heart with radioisotopes is described. It allows a precise determination of circulation through the auricle and ventricle following administration of a bolus of ^{99m}Tc-pertechnetate, and an evaluation of the cardiac function. The method is safer than contrast angiographic radiographic techniques. (tr-auth)

29899 (CONF-720699-P2, pp 300-310) QUANTITATIVE RADIOISOTOPIC ANGIOCARDIOGRAPHY. Weber, P. M.; dos Remedios, L. V.; Jasko, I. A. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The analysis of the curves obtained from radioisotope scintigraphic measurements of blood circulation in the heart gives a very precise diagnosis of lesions of the heart and large vessels and may be used for quantitative evaluation of several important parameters of the blood circulation. The technique required to obtain these data is described. The calculations used to obtain the clinically and physiologically significant blood circulation parameters are discussed. Several clinical examples in which ^{99m}Tc-human serum albumin was used as the tracer are given to illustrate the usefulness of this technique. (tr-auth)

29900 (CONF-720699-P3) PROCEEDINGS OF 14TH COLLOQUIUM ON NUCLEAR MEDICINE, TOURS, FRANCE, JUNE 9-10, 1972. Volume 3. (Centre Hospitalier Regional Bretonneau, 37 - Tours (France). Service d'Explorations Fonctionnelles par les Methodes Physiques). 1972. 121p. (In French).

Separate abstracts were prepared for 19 papers included. (CH)

For abstracts of individual papers see: 29133, 29426, 29427, and 29901–29916.

29901 (CONF-720699-P3, pp 328-339) EMERGENCY EXAMINATIONS IN NUCLEAR MEDICINE. Delaloye, B. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The different types of emergency scintigraphic examinations made with radioisotopes are outlined. The degree of urgency is categorized, according to the time allowed for therapeutic measures, as imperative, primary, and deferred. In the primary emergencies are those involving percardiac effusion, pulmonary embolisms, and measurement of cardiac output. Deferred emergencies include the scintigraphy of cardiac cavities or cerebral explorations. The organization of an emergency laboratory in nuclear medicine is outlined and the apparatus needed is described. (JSR)

29902 (CONF-720699-P3, pp 340-352) EMERGENCY EXAMINATIONS IN NUCLEAR MEDICINE: INTERVENTION. Plagne, R.; Gouaze, A. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The emergency scintigraphic examination of the abdomen, kidneys, or head after trauma and the place of emergency examinations in neurosurgery are discussed. Emergency conditions discussed include extradural hematoma, hemorrhagic incidents, decompensating tumors, and cerebral vascular incidents. (JSR)

29903 (CONF-720699-P3, pp 356-363) BASEDOW'S DISEASE AND THE MEASUREMENT OF THE ABSOLUTE UPTAKE OF STABLE IODINE BY THE THYROID. Mornex, R.; Berthezene, F.; Chavrier, B. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The absolute uptake of iodine by the thyroid was measured by radiometric analysis of samples of urine and blood plasma following oral administration of a tracer dose of ^{131}I in 28 euthyroid subjects as 2.1 g/hr for 70 kg (0.5 to 8.3). In patients with hyperthyroidism the ^{131}I uptake was 29.1 (from 3.5 to 236.6) and of 150 patients only 5 were in the normal range. There was some proportionality between the intensity of the absolute uptake of iodine and the resistance of the patient to radioisotopic treatment. Four months after a therapeutic dose of ^{131}I was administered all the recovered patients had an uptake close to normal. When all the clinical symptoms disappeared the normalization of the uptake indicates a spontaneous cure and counter-indicates the administration of an additional dose of radioiodine. (tr-auth)

29904 (CONF-720699-P3, pp 364-370) BONDING OF VITAMIN D_3 TO PLASMA PROTEINS. Baret, A.; Rugiero, R.; Morcellet, J. L. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

Results are reported from ^{14}C and ^{3}H tracer on the nature of the bonding of carrier proteins and cholecalciferol (vitamin-D_3). Plasma chromatographs showed several vitamin D carrier proteins. Particularly the results confirmed α-2-macroglobulin as a specific carrier protein. A prealbumin fraction is shown to have an affinity. A competitive adsorption technique applicable to the vitamin D_3–protein system showed the existence of free vitamin D_3 and a competition between the vitamin D_3 proteins for protein sites. (tr-auth)

29905 (CONF-720699-P3, pp 372-377) ^{99m}TECHNETIUM–ANTIMONY: VALIDITY OF THIS COMPLEX AS A RENAL SCINTIGRAPHIC AGENT. Morcellet, J. L.; Baret, A.; Ramon, V.; Le Mignant, A. (Centre d'Etudes et de Recherches Biophysiologiques, Toulon, France). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

Studies were made to determine the renal uptake of a colloid of antimony sulfide labeled with ^{99m}Tc and its suitability as a renal scintigraphic agent. The results showed that the ^{99m}Tc-Sb complex is an excellent scintigraphic agent for the liver and spleen in the form of a colloidal sulfide. The method of preparation gives a reproducibly pure (90%) stable product which distinguishes it from previously used compounds (^{99m}Tc-DTPA and ascorbate–Fe–^{99m}Tc). It is similar to them in biological behavior but gives a higher retention rate in the kidney and lower in the liver. (tr-auth)

29906 (CONF-720699-P3, pp 378-383) TECHNIQUE OF EXPLORATION OF PULMONARY FUNCTION BY XENON-133. Radermecker, R.; Bartsch, P.; Petit, J. M. (Univ., Liege). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The application of ^{133}Xe to routine respiratory functional studies to evaluate the perfusion and ventilation efficiency and to determine their ratios in various pulmonary regions was studied. The ^{133}Xe was inhaled in gaseous form for the ventilation studies and given in solution in physiological fluids for intravenous injections for the perfusion studies. The methods used for scintiscanning and data calculations are described. Typical results are shown and indicate that the technique can be used in routine situations. The radiation exposure of both patient and medical personnel is minimal. (JSR)

29907 (CONF-720699-P3, pp 384-390) RESULT OF THE EXPLORATION OF THE PULMONARY FUNCTION BY XENON-133. Bartsch, P.; Radermecker, R.; Petit, J. M. (Univ., Liege). 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The principal results obtained in the ^{133}Xe scintigraphic study of regional lung respiratory function and blood perfusion in cases of pneumoconiosis, vesicular emphysema, neoplasms, and McLeod syndrome are briefly discussed. (JSR)

29908 (CONF-720699-P3, pp 392-395) ORBITAL GAMMA SCINTIGRAPHY WITH ^{99m}Tc (TcO_4 AND COMPLEX FERROUS Tc-ASCORBATE). Boudet, C. (Service d'Ophtalmologie, Montpellier, France); Bastons, G.; Arnaud. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The use of TcO_4 and complex ferrous Tc-ascorbate labeled with ^{99m}Tc for the γ scintigraphy of eyes was investigated. The results indicated that the complex gave better contrast images with a lower scattered activity of the periorbital and retroorbital regions. The technique, because of its simplicity and rapidity, can be used routinely in the exploration of orbital pathology. Its principal indication is for the evaluation of exophthalmos, where rapid scanning will confirm or negate the existence of a tumor or intraorbital vascular lesion. (JSR)

29909 (CONF-720699-P3, pp 396-400) DETERMINATION OF RENAL CLEARANCE IN NUCLEAR MEDICINE. Methods, Evaluations, and Results. Oberhaussen, E.; Berberich, R.; Heinrich, W.; Gloebel, B. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A method for the calculation of renal clearance of radiotracers is described. It is illustrated with a calculation of the ^{131}I-hippuran or ^{51}Cr-EDTA clearance and the bilateral clearance and the results are compared with those obtained by the classic dye clearance tests. (JSR)

29910 (CONF-720699-P3, pp 402-406) DETERMINATION OF THE INTRARENAL BLOOD OUTPUT BY INJECTION OF ^{133}Xe IN THE AORTA. Collard, M.; Guey, A.; Mehari, M. F.; Zech, P. Y.; Traeger, J.; Tran-Minh, V.; Pinet, A. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

The classical method for the measurement of intrarenal blood output is made by injection of ^{133}Xe in the renal artery. The simultaneous measurement of the output of each kidney after a single injection of the tracer in the aorta has several advantages over the classical method. These are the rigorous comparison of the output of each kidney, the possible study in acute renal insufficiency of the effect of pharmacodynamic agents, and to mitigate the possibility of catherizing a stenosed renal artery. The experimental apparatus used in this technique is described. (tr-auth)

29911 (CONF-720699-P3, pp 408-412) METHOD OF CLINICAL STUDY OF PULMONARY PURIFICATION. Production of Radioactive Calibrated (Latex) Polystyrene Balls. Magdelenat, H. (Institut du Radium, Paris); Roy, M.; Gongora, R.; Gongora, G.; Jammet, H.; Bardy, A.; Beydon, J.; Hegesippe, H. 1972. (In French).

From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).

A technique was developed for the preparation of microspheres of ^{51}Cr-labeled latex. The product was submitted for toxicity and sterility studies. Animal studies were made on its labeling stability and on its suitability for scintiscanning the lungs for measurements of respiratory function after inhalation of the aerosol. The results of the studies lead to the recommendation that it be used in human pulmonary clearance studies. (JSR)

29912 (CONF-720699-P3, pp 414-415) RADIOIMMUNOLOGICAL DETERMINATION OF THE IMMUNOGLOBULIN E.

First Results. Halpern, G.; Levy, C. 1972. (In French).
From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).
The first results obtained in the study of the amount of serum immunoglobulin E (IgE) present in allergic patients, in patients with parasitosis, and in normal subjects are reported. The results of radioimmunoassay studies confirm that IgE is normally present in very small amounts. The amount of IgE is elevated in some circumstances but the importance of this elevation has not been defined. (JSR)

29913 (CONF-720699-P3, pp 430-437) SIMULTANEOUS QUANTITATIVE DETERMINATION OF THE DAILY DEGRADATION RATE OF THYROXINE AND TRI-IODO-THYRONINE AND KINETIC STUDY OF THE DEGRADATION PRODUCTS. Paulin, R.; de Laforte, C.; Bisset, J. P.; Carayon, P.; San Marco, J. L. 1972. (In French).
From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).
A radioimmunoassay method was developed for the simultaneous determination of T_3, iodoproteins, and iodides in blood serum samples. It is based on the Blanquet–Meyniel method for the separation of the iodated compounds in blood. The degradation of T_3 and T_4 was followed in normal subjects, in hyperthyroid patients, and in elderly patients with hypometabolism. The results obtained are graphed. (JSR)

29914 (CONF-720699-P3, pp 440-442) DETERMINATION OF THE AUSTRALIA ANTIGEN BY A RADIOMETRIC METHOD. Application to Blood Derivatives Used as Biological Tracers. Amouch, P.; Drouet, J. 1972. (In French).
From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).
A technique was developed for the routine radioimmunoassay determination of the Australia antigen which is associated with viral hepatitis. The method consists in placing Australia antigen labeled with ^{125}I in competition with a specific antibody. The results show that the radioimmunoassay method is more sensitive than the usual methods. (JSR)

29915 (CONF-720699-P3, pp 444-447) USE OF ^{99m}Tc-LABELED SODIUM PYROPHOSPHATE IN SKELETON SCINTIGRAPHY. Perez, R.; Cohen, Y.; Henry, R.; Panneciere, C. 1972. (In French).
From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).
The use of ^{99m}Tc-sodium pyrophosphate in skeleton scintigraphy was studied in the rat. Chromatographic studies, measurement of the osmolarity, toxicity studies, and scintigraphic studies were made. The pharmacokinetic tests made included blood clearance of the complex, urinary elimination, and bone incorporation. The animal studies permitted clinical studies and typical scintigraphs obtained are shown. (JSR)

29916 (CONF-720699-P3, pp 452-455) PRELIMINARY EXPERIENCE WITH A RADIOIMMUNOLOGICAL TEST FOR THE AUSTRALIA ANTIGEN. Tauxe, N. 1972. (In French).
From 14th colloquium on nuclear medicine; Tours, France (9 Jun 1972).
The data obtained during the use of a radioimmunological test for the Australia antigen (the antigen associated with viral hepatitis) are reported. The studies were made on serum from blood donors, from transfused patients, and patients hospitalized for hepatitis. The test protocol is described in some detail. (JSR)

29917 (COO-2031-2) RADIOPHARMACEUTICALS FOR DIAGNOSIS AND TREATMENT. A.E.C. Competing Renewal, 1974. Beierwaltes, W. H. (Michigan Univ., Ann Arbor (USA)). 1974. 13p. Dep. NTIS $4.00.
The tissue distribution of several new radiopharmaceuticals prepared for use for scintiscanning for localization or for therapy of neoplasms was studied in laboratory animals or human patients. Data are presented on the tissue distribution of ^{14}C-labeled dopamine and several dopamine analogs in rats; the uptake of ^{131}I-19-iodocholesterol by adrenal aldosteromas in human patients; the uptake of ^{14}C-dopamine by pheochromocytomas in human patients; the uptake of ^{14}C- or ^{131}I-labeled oleic acid, ^{131}I-linoleic acid, and ^{3}H-lecithin by the myocardium in rats and dogs; the uptake of ^{14}C-estradiol by the adrenal cortex in dogs; the uptake of ^{14}C-isoxazole (17-β-hydroxy-4,4' 17α-trimethylandrost-5-ene-(2,3,e)l) by the adrenal medulla in dogs; the uptake of ^{14}C- and ^{3}H-labeled streptozotocin by the pancreas islet cells in dogs and toadfish (Opsanus tau); the uptake of ^{14}C-diphenylhydontoin by pancreas islet cells in the toadfish; and the uptake of bleomycin labeled with ^{64}Cu, ^{3}H, or ^{99m}Tc by breast neoplasms in rats. (CH)

29918 (IEA-280) RADIOISOTOPE PROFILE SCANNING TECHNIQUES FOR DIAGNOSIS OF DISEASES OF THE VERTEBRAL CANAL, SPINAL CORD, AND ITS MEMBRANES. Part I. Description, Characteristics, and Performance of the Detection and Scanning System. Thom, A. F.; Pieroni, R. R.; Kieffer, J. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Nov 1972. 21p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $4.25.
Profile scanning following the injection of ^{131}I-human serum albumin is proposed as a suitable technique for studies of the disorders of cerebrospinal fluid dynamics due to pathologic processes envolving the vertebral canal, the spinal cord, and its membranes. The detection system is described and the characteristics as well as the performance are determined by experiences in vitro. It is concluded that the system can be considered an adequate tool to study the distribution of radioactive tracers along the medullary canal. (auth)

29919 (IEA-281) RADIOISOTOPE PROFILE SCANNING TECHNIQUES FOR DIAGNOSIS OF DISEASES OF THE VERTEBRAL CANAL, SPINAL CORD, AND ITS MEMBRANES, PART II. Application to Clinical Investigations and Basic Research. Thom, A. F.; Pieroni, R. R.; Kieffer, J. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Nov 1972. 36p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $5.00.
A method that was developed for radioisotope profile scanning of the vertebral canal was tried as a diagnostic procedure for the detection of perimedullary subarchnoid blocks and as a technique for basic research. Three groups of patients studied included: 6 normal controls; 7 patients with diagnosted cerebrospinal fluid blocks; and 5 patients with neurologic syndromes but with negative or inconclusive conventional tests. The site and type of the block could be recognized in all patients and abnormal profiles indicated disturbances of CSF dynamics in all cases. (auth)

29920 (IEA-289) RADIOIMMUNOASSAY OF INSULIN IN THE HUMAN PLASMA. Torres de Toledo e Souza, L.; Higa, O. Z.; Wajchenberg, B. L.; Pinto, H.; Pieroni, R. R. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1973. 21p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $4.25.
Methods are described for the radioimmunoassay of insulin in human plasma. (CH)

29921 (ORO-1643-119) STUDIES IN IODINE METABOLISM. Progress Report, June 1973–March 1974. Modification No. 22. Van Middlesworth, L. (Tennessee Univ., Memphis (USA). Dept. of Physiology and Biophysics). 1974. Contract AT(40-1)-1643. 40p. Dep. NTIS $5.00.
Investigations during the past nine months have included the following subjects: barium and sulfur with radium concentrated in bovine thyroids; radium in bovine thyroids from Colorado; elemental analysis of psammoma bodies, from human thyroid carcinoma; elemental analysis of experimental psammona bodies compared to psammoma bodies in carcinoma; developmental studies of rats maintained on low iodine diets; synthesis of abnormal thyroglobulin in rats maintained on low iodine diet for long durations; effects of ClO_4 with NaI on iodine retention in thyroid glands; comment regarding radioimmunoassay (RIA) of T_3 in normal human feces; and continuous measurement of ^{131}I fallout in animal thyroids. (auth)

29922 (ORO-4023-5) STUDIES OF DROSOPHILA DISPERSAL AND MIGRATION BY NEUTRON ACTIVATION AND GENETIC TECHNIQUES. Progress Report. Richardson, R. H. (Texas Univ., Austin (USA). Dept. of Zoology). 1 Apr 1974. Contract AT(40-1)-4023. 263p. Dep. NTIS $16.25.
Techniques were developed to study dispersal behavior of Drosophila free of the principal disturbances caused by previous experimental designs, particularly baiting effects and local disturbances of natural density. Components of dispersal behavior were identified and responses analyzed. The conditions for sporadic long-range movements of Drosophila mimica, a species endemic to Hawaii, were predicted, and are now being tested in the field. Additional dispersal studies on two cactiphilic species, D. pachea and D. mojavensis, were conducted, and the data are being analyzed. (CH)

29923 (ORO-4106-12) HORMONALLY-INDUCED DAILY FLUCTUATIONS IN PLASMA CALCIUM AND PHOSPHATE CONCENTRATIONS IN THE RAT. Talmage, R. V.; Roycroft, J. H.; Anderson, J. J. B. (North Carolina Univ., Chapel Hill (USA). School of Medicine). 1974. Contract AT(40-1)-4106. 22p. Dep. NTIS $4.25.
Daily fluctuations in plasma calcium, phosphate and their radionuclides (preinjected) were determined in rats maintained on a closely controlled feeding and light schedule. Male rats (150 to 300 g) were trained to a 7 a.m. to 7 p.m. light schedule with food available 9 p.m. to 9 a.m. All tested values dropped rapidly at the start of each feeding period. These values rose

during the day. Continuous access to food produced an earlier fall (5 p.m.) in all plasma values. In thyroidectomized rats (with parathyroid transplants) plasma calcium and P_i remained relatively constant during the 24 hr period. If the time of availability of food was moved 6 hrs earlier (no change in light cycle), the drop in these plasma values also occurred 6 hrs earlier. Closer examination of these daily changes indicated that all values fell at least 1 hr prior to feeding. In fasted rats, plasma calcium and phosphate concentrations fell as usual; however, ^{45}Ca and ^{32}P rose instead of falling. It is concluded that, in normal rats, changes in endogenous calcitonin secretion may actually increase rather than decrease daily perturbations of plasma calcium and phosphate. Daily changes in these values are influenced by a conditioned reflex developed due to the feeding habits of the rats. Finally, it is suggested that intestinal hormones rather than calcium are the primary controls of calcitonin secretion. (auth)

29924 (STI/PUB-360) TRACER TECHNIQUES IN TROPICAL ANIMAL PRODUCTION. Panel Proceedings Series. Proceedings of a Panel on the Use of Nuclear Techniques in Some Aspects of Animal Production in Tropical Climates, Jakarta, Indonesia, October 16–20, 1972. Jan 1974. 215p. (CONF-7210115-). $10.00.

Eleven of the 17 papers presented were abstracted for inclusion in Nuclear Science Abstracts. The remaining papers discuss animal production problems for which tracer techniques might be useful. (MCG)

For abstracts of individual papers see: 29951–29961.

29925 RADIONUCLIDE IMAGING IN PRIMARY INTRACEREBRAL HEMORRHAGE. Shivers, J. A.; Adcock, D. F.; Guinto, F. C.; Radcliffe, W. B. (Univ. of North Carolina, Chapel Hill). Radiology; 111: No. 1, 211-212(Apr 1974).

Radionuclide images of patients with angiographically diagnosed primary intracerebral hemorrhage (ICH) were reviewed to determine the temporal relationship between a positive image and the onset of symptoms. Four of 9 brain images in 8 patients were positive; no definite temporal relationship was observed. The results suggest that current methods of radionuclide imaging have only a limited application in primary ICH. (auth)

29926 VENOPHOTOSCINTIGRAPHY IN RENAL TRANSPLANT RENOGRAMS: DEMONSTRATION OF AN UNUSUAL COMPLICATION. Reichert, J. R.; Tyson, I. B. (Univ. of Minnesota, Minneapolis). Radiology; 111: No. 1, 219-220(Apr 1974).

With the ipsilateral foot as the injection site, a renogram of a transplanted kidney demonstrated not only a patent renal artery but also partial obstruction of the left iliac vein at the site of anastomosis with the renal vein. (auth)

29927 HEPATIC SCINTIANGIOGRAPHIC PATTERNS. DeNardo, G. L.; Stadalnik, R. C.; DeNardo, S. J.; Raventos, A. (Sacramento Medical Center, CA). Radiology; 111: No. 1, 135-142(Apr 1974).

From 58th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (26 Nov 1972).

Additional information can be obtained by imaging the liver repeatedly during the first two minutes after intravenous injection of a bolus of ^{99m}Tc-sulfur colloid. This study is referred to as hepatic scintiangiography and depicts arterial and venous blood flow in the liver in a manner analogous to contrast angiography. In normal patients, radioactivity within the hepatic bed is greatly reduced during the arterial phase and increased during the venous phase. In patients with hepatic neoplasms, arterialization or "tumor stain" is seen at the site of the lesion. The scintiangiogram is normal in fatty metamorphosis but reveals diffuse arterialization in cirrhosis. Patients with amoebic abscess, cyst, or hematoma demonstrate decreased blood flow at the site of the lesion. (auth)

29928 ABNORMAL SCINTIANGIOGRAPHIC FINDINGS ASSOCIATED WITH SEIZURE ACTIVITY. Holmquest, D. L.; Launey, W. S. Jr. (Eisenhower Medical Center, Palm Desert, CA). Radiology; 111: No. 1, 147-150(Apr 1974).

Cerebral scintiangiography of 2 patients in status epilepticus showed intensive relative hyperperfusion of one hemisphere, although the static image remained normal. Following complete arrest of the seizure activity with appropriate therapy, cerebral blood flow returned to normal. This regional hyperperfusion is probably caused by increased local metabolic demands related to intense neuronal activity and should be differentiated from a neoplastic, vascular, or inflammatory lesion. (auth)

29929 OSSEOUS AND EXTRAOSSEOUS UPTAKE OF FLUORINE-18 AND TECHNETIUM-99m POLYPHOSPHATE IN CHILDREN WITH NEUROBLASTOMA. Rosenfield, N.; Treves, S. (Harvard Medical School, Boston). Radiology; 111: No. 1, 127-133(Apr 1974).

Fourteen bone scans were performed in 7 patients with neuroblastoma using ^{18}F and ^{99m}Tc-PP. Four patients had extraosseous uptake of ^{18}F, 2 in regions radiographically calcific, and 2 in noncalcified sites. Two of these patients showed no extraosseous uptake by ^{99m}Tc-PP. In a third, extraosseous uptake of ^{99m}Tc-PP was seen in multiple calcific locations. ^{18}F, ^{99m}Tc-PP, radiographs, and bone marrow biopsies all vary in the ability to detect bony metastases. This should be kept in mind when interpreting bone scans obtained with the newer agents. (auth)

29930 EFFECTS OF PAPAVERINE AND ISOPROTERENOL ON THE REGIONAL DISTRIBUTION OF MYOCARDIAL BLOOD FLOW IN DOGS. Moore, R.; Rizk, G.; Loken, M.; Amplatz, K. (Univ. of Minnesota, Minneapolis). Radiology; 111: No. 1, 157-160(Apr 1974).

From 58th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (26 Nov 1972).

The left anterior descending coronary artery was catheterized in dogs and 5 mCi of ^{133}Xe dissolved in 1 ml of isotonic saline was injected and flushed with 3 ml of isotonic saline. Regional myocardial blood flow rates were measured with a gamma camera before and after the administration of 500 μg/kg of papaverine or 10 μg/kg of isoproterenol. The average myocardial blood flow rate was 107 ± 13 (12%) ml/min/100 g of myocardium before the injection of papaverine and 190 ± 16 (9%) ml/min/100 g afterward. There was no difference in the rate of flow before or after the administration of isoproterenol. (auth)

29931 TOXICITY OF Sn-PYROPHOSPHATE: CLINICAL MANIFESTATIONS PRIOR TO ACUTE LD_{50}. Stevenson, J. S.; Eckelman, W. C.; Sobocinski, P. Z.; Reba, R. C.; Barron, E. L.; Levin, S. G. (Armed Forces Radiobiology Research Inst., Bethesda, MD). J. Nucl. Med.; 15: No. 4, 252-256(Apr 1974).

Following the administration of large amounts of technetium-Sn-phosphate compounds in rats, tetany appears to be the primary clinical manifestation. To evaluate this phenomenon, acute LD_{50} (5 min) was determined and serum calcium and arterial plasma pCO_2 were measured and related to the administered dose. The LD_{50} (5 min) for pyrophosphate was found to be 41.0 ± 1.6 mg/kg (2 s.d.) body weight whereas the LD_{50} (5 min) for polyphosphate was found to be 29.4 ± 2.0 mg/kg (2 s.d.) body weight. There was no significant difference between the slopes of the two compounds. When acute LD_{50}s are compared, polyphosphate was 1.4 times more toxic than pyrophosphate. Arterial blood pCO_2 remained between 30 and 40 Torr until doses of pyrophosphate exceeded 35 mg/kg body weight, after which it fell sharply. Serum calcium concentration was monitored by atomic absorption spectroscopy and electrocardiography. There was a significant drop in the ionized and bound calcium concentrations beginning at an administered dose of 20 mg/kg body weight. Electrocardiographic changes consistent with hypocalcemia were recognized after injection of 12 mg/kg body weight. However, tetany was not apparent until 22 mg/kg body weight of pyrophosphate was given. Therefore, evaluation of the toxic effects of phosphate agents should not be limited to determination of LD_{50} alone but should include appropriate biochemical measurements in blood. (auth)

29932 EVALUATION OF CLINICAL VALUE OF ^{123}I AND ^{131}I IN THYROID DISEASE. Nishiyama, H.; Sodd, V. J.; Berke, R. A.; Saenger, E. L. (Univ. of Cincinnati). J. Nucl. Med.; 15: No. 4, 261-265(Apr 1974).

Comparison of ^{123}I and ^{131}I for thyroid scans and uptakes was undertaken to evaluate their diagnostic values in conjunction with instrumental efficacy for ^{123}I. By far the superior quality images were obtained with ^{123}I. Further, both the lower absorbed radiation dose and the shorter scanning time required indicate that ^{123}I is the radionuclide of choice for thyroid studies. (auth)

29933 ^{111}In-BLEOMYCIN KINETICS IN MICE BEARING TRANSPLANTABLE TUMORS OF LUNG, SKIN, AND BONE. Robbins, P. J.; Silberstein, E. B.; Fortman, D. L. (Univ. of Cincinnati Medical Center). J. Nucl. Med.; 15: No. 4, 273-278(Apr 1974).

Stable and chemically pure ^{111}In-bleomycin for injection can be prepared easily from carrier-free $^{111}InCl_3$ and an aqueous solution of bleomycin by mixing the two at pH 1.5, adjusting the pH to 6.5 to 7, and autoclaving. This radiopharmaceutical shows definite tumor affinity within an hour after injection as would be predicted from its efficacy as a chemotherapeutic agent, but optimum ^{111}In tumor-to-blood ratios in three transplantable mouse tumors are not reached for 2 days. At 48 hr postinjection, it is not known if ^{111}In is still chelated to bleomycin. (auth)

29934 ^{99m}Tc-PYROPHOSPHATE FOR BONE IMAGING. Eckelman, W. C.; Reba, R. C.; Kubota, H.; Stevenson, J. S. (George Washington Univ., Washington, DC). J. Nucl. Med.; 15: No. 4, 279-283(Apr 1974).

Of the various ^{99m}Tc-phosphates suggested for bone imaging, ^{99m}Tc-pyrophosphate appears to have the desirable characteristics of commercial availability of sodium pyrophosphate and analytical controls available to assure the quality of the final product. Systematic variations of the parameters of the ^{99m}Tc-tin-pyrophosphate preparations were evaluated by gamma camera images in swine. These studies indicate that the best distribution is obtained by adding 1.75 ml of 0.1 M sodium pyrophosphate at pH 10 to 0.25 ml of 1 mg/ml stannous chloride followed by 1.50 ml $^{99m}TcO_4^-$. In vivo organ distribution indicates the importance of normalizing doses on a per weight basis for comparative animal studies. Data reported for ^{99m}Tc-phosphates without consideration of the dose on a weight basis can be misleading. If the optimal dose of pyrophosphate is used, ^{99m}Tc-pyrophosphate results in high-quality bone images in animals and humans and can be easily prepared and assayed. (auth)

29935 INHIBITION OF FORMATE AND FORMALDEHYDE OXIDATION BY ETHANOL AS AN INDEX FOR ESTIMATING ALCOHOL CONCENTRATION IN ISOLATED TISSUES. Tran, N.; LeBel, E. (Centre Hospitalier Univ., Sherbrooke, Quebec). J. Nucl. Med.; 15: No. 4, 284-287(Apr 1974).

The presence of enzymes, possibly tetrahydrofolate, involved in the oxidation of both formaldehyde and formate in human or rat RBC and rat livers, but not in rat brains, has been demonstrated. The inhibition of oxidation of either ^{14}C-formate or ^{14}C-formaldehyde to $^{14}CO_2$ by various concentrations of ethanol in rat livers may be considered as an index for estimating alcohol concentrations in human isolated tissues without radiation danger. Immediate and accurate results obtained demonstrated also that this in vitro ionization chamber method with ^{14}C-labeled formate or formaldehyde would surpass spectrophotometric procedures because of its rapidity and reliability. (auth)

29936 SIMPLE ^{133}Xe DELIVERY SYSTEM FOR STUDIES OF REGIONAL VENTILATION. Secker-Walker, R. H.; Barbier, J.; Wiener, S. N.; Alderson, P. O. (Washington Univ. School of Medicine, St. Louis). J. Nucl. Med.; 15: No. 4, 288-290(Apr 1974).

An apparatus for delivering ^{133}Xe for studies of regional ventilation and its mode of operation is described. The apparatus is constructed from commercially available parts. The apparatus has proven simple to operate and satisfactory studies can be obtained with 10 mCi of ^{133}Xe. (auth)

29937 SPLENIC RADIOCOLLOID UPTAKE IN THE PRESENCE OF CIRCULATING HOWELL–JOLLY BODIES. Spencer R. P.; Pearson, H. A. (Yale Univ. School of Medicine, New Haven). J. Nucl. Med.; 15: No. 4, 294-295(Apr 1974).

Three cases are described where there were circulating Howell–Jolly bodies while the spleen still possessed the ability to accumulate radioactive colloid. Hence there is a disassociation of splenic functions, but whether this is a qualitative or quantitative effect is uncertain. Literature data pointing out other disassociations of splenic activities are mentioned. In the cases in this report there were severe hematologic stresses with an outpouring of reticulocytes. Thus a great number of cells were likely presented for clearance of Howell–Jolly bodies, and this load could have been excessive. Hence the designation "overload syndrome" may be appropriate. (auth)

29938 RADIONUCLIDE SCANNING OF THE LIVER IN PRIMARY HEPATIC CANCER: AN ANALYSIS OF 202 CASES. Levin, J.; Geddes, E. W.; Kew, M. C. (Johannesburg General Hospital). J. Nucl. Med.; 15: No. 4, 296-299(Apr 1974).

Radionuclide liver scans on 202 patients with primary cancer of the liver were reviewed. With one expection, all were abnormal. A single filling defect was present in 72% of the patients, two or more defects in 15%, and extensive patchy replacement of liver tissue in 12%. Two patients showed a picture indistinguishable from that seen in hepatic cirrhosis. The lesions occurred most commonly in the right lobe of the liver. The importance of doing a right lateral scan in addition to an anterior scan and of marking the palpable edge of the liver was emphasized by certain cases. Hepatic scintiscanning proved to be a more sensitive indicator of the presence of a primary hepatic tumor than biochemical disturbances. There were, however, no features on the scan that made it possible to distinguish between a primary tumor and other space-occupying or infiltrative lesions of the liver. No obvious correlation could be demonstrated between the presence of alpha-fetoprotein in the serum and the extent of the tumor on the scan. Hepatic scintiscanning is valuable in determining the optimal site for percutaneous biopsy and in assessing suitability for surgical resection. (auth)

29939 RADIONUCLIDE STUDIES IN VASCULAR INFANTILE HEMIPLEGIA. Aita, J. F.; Keyes, J. W. Jr. (Univ. of Rochester, NY). J. Nucl. Med.; 15: No. 4, 300-302(Apr 1974).

Two cases of acute infantile hemiplegia are presented. The first case is a patient with moyamoya disease with excellent correlation between the brain scan findings and her clinical signs and symptoms and the carotid arteriogram. The second patient had occlusive cerebrovascular disease secondary to thromboemboli with excellent correlation between the brain scan findings and his clinical state and the neuropathologic examination. In both cases the static brain scans and the radionuclide angiogram were comparable to those reported in adults with cerebrovascular disease both in appearance and in temporal sequence. Radionuclide studies can be an important and reliable diagnostic tool in the evaluation of acute infantile hemiplegia. (auth)

29940 HEALING OF A SPLENIC INFARCT. Spencer, R. P. (Yale Univ., New Haven). J. Nucl. Med.; 15: No. 4, 303-304(Apr 1974).

A case of splenic infarction showed resolution of the defect over a period of 17 days with some loss of splenic volume. Scanning was performed using ^{99m}Tc-sulfur colloid. (auth)

29941 HOT HEPATIC ABSCESS. Chayes, Z. (Yeshiva Univ., Bronx, NY). J. Nucl. Med.; 15: No. 4, 305-307(Apr 1974).

A case of hepatic abscess appearing as a hot lesion on the radiocolloid scintigraph is presented. Local stimulation of reticuloendothelial elements is suggested as the probable explanation for this unusual finding. Focal liver lesions demonstrating increased radiocolloid uptake have been described over the past few years in association with hemangioma and various venous obstructions. In this report an abscess is documented as another lesion producing a focal increase in hepatic radiocolloid concentration. (auth)

29942 ^{67}Ga LOCALIZATION IN ACUTE CEREBRAL INFARCTION. Wallner, R. J.; Croll, M. N.; Brady, L. W. (Hahnemann Medical Coll. and Hospital, Philadelphia). J. Nucl. Med.; 15: No. 4, 308-309(Apr 1974).

Gallium-67 first gained recognition as a possible tumor-specific scanning agent in epithelial and reticuloendothelial neoplasms. Recent reports have described localization of this isotope in various nonmalignant disease states including acute inflammatory processes and chronic granulomatous diseases. A case is presented of ^{67}Ga-citrate localization in acute cerebral infarction. (auth)

29943 PREOPERATIVE DIAGNOSIS OF ASYMPTOMATIC CHOLEDOCHAL CYST BY ROSE BENGAL LIVER SCAN. Park, C. H.; Garafola, J. H.; O'Hara, A. E. (Thomas Jefferson Univ. Hospital, Philadelphia). J. Nucl. Med.; 15: No. 4, 310-311(Apr 1974).

The number of choledochal cysts reported in the literature has increased in recent years. The classic triad of abdominal pain, jaundice, and an abdominal mass leads to suspicion of the diagnosis in less than 20% of cases. The purpose of this report is to emphasize that rose bengal liver scanning is the most definitive and atraumatic method of diagnosing choledochal cyst in jaundiced or nonjaundiced patients. (auth)

29944 POSITIVE ^{99m}Tc-POLYPHOSPHATE BONE SCAN IN A CASE OF SECONDARY HYPERTROPHIC OSTEOARTHROPATHY. Kay, C. J.; Rosenberg, M. A. (Park City Hospital Bridgeport, CT). J. Nucl. Med.; 15: No. 4, 312-313(Apr 1974).

Secondary hypertrophic osteoarthropathy of the upper extremities is demonstrated by ^{99m}Tc-polyphosphate in an 11-year-old boy with Hodgkin's disease of the mediastinum. (auth)

29945 IMAGING FUNCTIONAL NODULES OF THE ADRENAL GLANDS WITH ^{131}I-19-IODOCHOLESTEROL. Beierwaltes, W. H.; Sturman, M. F.; Ryo, U.; Ice, R. D. (Univ. of Michigan, Ann Arbor). J. Nucl. Med.; 15: No. 4, 246-251(Apr 1974).

Only in the instance of the hyperfunctioning adrenal cortical adenoma with Cushing's syndrome is the uptake of the ^{131}I-19-iodocholesterol markedly decreased to absent in the adrenal cortices outside the adenoma. The mechanism for this lack of function outside the hyperfunctioning adrenal cortical adenoma presumably is suppression of pituitary ACTH by cortisol excess from the adrenal cortical adenoma resulting in subnormal stimulation of normal adrenocortical tissue. We report the occurrence of hyperactivity in one adrenal gland presumably from a functioning nodule, resulting in increased uptake with suppressed uptake of ^{131}I-19-iodocholesterol in the contralateral adrenal cortex in the absence of Cushing's syndrome. One 67-year-old woman had diabetes mellitus, a massively fatty liver, a dexamethasone nonsuppressible uptake of ^{131}I-19-iodocholesterol in her right adrenal nodule, and a normal response to ACTH stimulation of the opposite adrenal gland. A 21-year-old woman had obesity, diabetes, progressive hirsuitism, sterility, and slightly elevated urinary 17-ketosteroid excretion. The increased uptake in the hot nodule in the right adrenal was suppressible with dexamethasone and

ACTH produced a normal uptake in the opposite adrenal gland. The similarity of these functional nodules in the adrenal cortices to functional nodules previously observed in the thyroid gland with ^{131}I is apparent. (auth)

29946 SCINTISCANNING OF PULMONARY DISEASES WITH ^{67}Ga-CITRATE. Kinoshita, F.; Ushio, T.; Maekawa, A.; Ariwa, R.; Kubo, A. (Ohkubo Municipal Hospital, Tokyo). J. Nucl. Med.; 15: No. 4, 227-233(Apr 1974).

Scintiscanning with ^{67}Ga-citrate was performed in 162 patients with various pulmonary diseases. Of the 70 cases of primary pulmonary carcinoma, 62 had a strongly positive and 7 a slightly positive scan and all 18 cases of metastatic pulmonary carcinoma had a positive scan, including a carcinoma of 1 to 2 cm in diam. According to the histopathological findings, the positive rate for squamous cell carcinoma and undifferentiated carcinoma tended to be higher than that for adenocarcinoma. By indicating the presence of infiltration of lymphatic metastasis in the mediastinum for which the roentgenologic diagnosis is difficult or a tumor which overlaps the heart shadow or is hidden in a large hydrothorax, ^{67}Ga-citrate scanning has contributed valuable information on which to base a decision for operating or choice of surgical method and the establishment of the range of radiotherapy. Otherwise inflammatory lesions (pneumonia, purulent pulmonary infection, pulmonary tuberculosis, etc.) and sarcoidosis had more clearly positive scans in the acute stage than did carcinoma. (auth)

29947 FALSE-NEGATIVE ^{75}Se-SELENOMETHIONINE SCANS IN PRIMARY LIVER CANCER. Kew, M. C.; Geddes, E. W.; Levin, J. (Univ. of the Witwatersrand, Johannesburg). J. Nucl. Med.; 15: No. 4, 234-236(Apr 1974).

Selenium-75-selenomethionine and ^{99m}Tc-sulfur colloid scans were performed in 45 Southern African blacks with proven primary cancer of the liver and 28 patients with other space-occupying hepatic lesions. In six of the cancer patients, the defect or defects visible on the ^{99m}Tc-sulfur colloid scan were not seen on the ^{75}Se-selenomethionine scan, and in 17 patients they had partially disappeared. In the remaining 22 cancer patients and the 28 control patients the two scans were identical. The high incidence of failure of uptake of ^{75}Se-selenomethionine by the tumor is attributed to the anaplastic nature of the neoplasm and the frequency with which tumor necrosis occurs in Southern African blacks with primary cancer of the liver. (auth)

29948 RAPID EVALUATION OF HEPATIC SIZE ON RADIOISOTOPE SCAN. Rosenfield, A. T.; Schneider, P. B. (Beth Israel Hospital, Boston). J. Nucl. Med.; 15: No. 4, 237-240 (Apr 1974).

Multiple single measurements of hepatic size were performed on 100 random liver scans. These values were correlated with the presence or absence of hepatic disease. The best indicator of liver pathology is shown to be a vertical measurement halfway between the xiphoid and right liver margin. An upper limit of normal can be chosen that provides an index of hepatic disease when exceeded. In our series, this upper limit was 15.5 cm but this number may vary with technique. Diagonal measurements, maximum vertical and horizontal measurements, and area calculations provided a less reliable upper limit in our series. Thus a simple technique has been defined which provides a valuable tool for radioisotope scan evaluation. (auth)

29949 EFFECT OF MUD BATH ON ACTIVE CONGESTION AS INDICATED BY RATE OF ^{131}I RESORPTION FROM SUBCUTANEOUS RESERVOIR. Galovic, A. (Zlate Moravce Hospital, Czech.); Kolar, J.; Trnovec, T. Bratislav. Lek. Listy; 59: No. 2, 148-151(Feb 1973). (In Czech).

The effect of mud bath on the ^{131}I resorption rate from a subcutaneous reservoir was studied radiometrically in rabbits. Compared to controls, the resorption was found to proceed faster by 10% 5 mins after the radioiodine administration and faster by 30% 10 mins after administration to reach a steady rate exceeding that of the controls by 30 to 35% till the end of investigation. The analysis of the resorption curves also showed marked qualitative differences between the controls and the experimental animals. The results proved that a bath with the Piešťany mud effected an active congestion of the site of application. (Nuclear Sci. Abstr. Czech.)

29950 ENZYME DETERMINATION BY RADIOCHEMICAL METHODS: SERUM ARGINASE AND ITS CLINICAL USE IN LIVER DISEASES. Carulli, N. (Univ., Modena, Italy). Quad. Sclavo Diagn. Clin. Lab.; 8: No. 1, 301-309(Mar 1972). (In Italian).

Enzyme assay by radiochemical methods is reviewed; the higher sensitivity that can be achieved with such methods is compared to the traditional ones. A radiometric method for arginase assay is presented. The method is based on the splitting of a labeled substrate (arginine-guanido-^{14}C) and on the subsequent hydrolisis of one of the reaction product (urea-^{14}C) to yield ^{14}C) labeled carbon dioxide that is then counted in a liquid scintillation spectrometer. This method has proved to be very sensitive and its clinical application in the field of liver diseases is discussed. (auth)

29951 TRACERS IN FIELD MEASUREMENTS OF WATER, MILK, AND THYROXINE METABOLISM OF TROPICAL RUMINANTS. Macfarlane, W. V.; Howard, B.; Good, B. F. (Waite Agricultural Research Inst., Glen Osmond, Australia). pp 1-23 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

Productive animals in the tropics may need to be adapted to hot-wet, or to alternating hot-wet and hot-dry environments. In both climates water is important both for metabolism and for cooling. Isotopes are useful in measuring content and the turnover rate of water. Water content (^{3}HHO) gives field information on body solids, fat and protein content in relation to pasture and metabolic drain (as in starvation or lactation). Water turnover is closely linked with energy turnover. There is, among domestic stock, a hierarchy of turnover rates. High water turnover is found in tropical mammals such as buffalo, Banteng, cattle, eland, and pig. There are intermediate rates of water use in sheep, goat, or wildebeest. Low rates of energy and water turnover occur in dry-country animals like camel or oryx. ^{3}HHO turnover relates to food intake and as more water is taken more food is eaten. But the rank order of animals for water turnover remains similar in different conditions, with different food supplies. Production of wool or milk is associated with proportional water turnover, and has a genetic basis. Water turnover of lambs or calves is a direct function of milk intake and ^{3}HHO yields both body solids increments, milk yield, and an efficiency measure of gain of solids per litre of milk integrated in the field. Large size is not necessarily associated with thermodynamic efficiency. Since metabolic rate is high in animals with high water turnover, it seemed likely that thyroxine would be related to those functions. Plasma bound iodine (^{131}I or ^{125}I) is very different in concentration in different genera and unrelated to rate functions. In the field, ruminant PBI is high in summer, low in winter. Thyroxine secretion rate (TSR) is low in large genera and high in small genera of ruminant. Secretion is higher in winter than summer, i.e., it is related reciprocally to the PBI levels. It is influenced greatly by food intake, rising with increasing food turnover and water turnover. Thyroxine seems to moderate intrinsic metabolic rates rather than set the rate of metabolism. (auth)

29952 ISOTOPIC TRACERS IN ENERGY METABOLISM STUDIES IN LIVESTOCK PRODUCTION IN DEVELOPING COUNTRIES IN THE TROPICS. Leng, R. A. (Univ. of New England, Amidale, Australia). pp 25-34 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

The future role of animals as producers of animal protein for the human population is discussed and it is concluded that ruminants have a major role in developing countries, particularly on diets based on agro-industrial by-products. It is suggested that the feeding trial is probably the most important technique for examining animal production but there is also a place for research using proven radioisotope techniques. A number of criteria for the application of isotopes are suggested. Isotopes mainly allow research in depth in particular areas, but there are a number of instances where isotopes are specifically applied tools, for example an isotope technique that measures carbon dioxide production in animals may be used to predict heat production in grazing or confined ruminants. Some considerations of animal production in developing countries are discussed in relation to defining the particular areas of research and particular emphasis is placed on upgrading local feeds and increasing the efficiency of utilization of feed by ruminants. A number of techniques that are useful are presented and it is pointed out where isotopes have particular applicability to well-designed feeding trials. (auth)

29953 TRACERS IN STUDIES ON LACTATION. Wright, D. E. (Ruakura Animal Research Station, Hamilton, N. Z.). pp 35-46 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

The use of isotopes in lactation research in ruminants is de-

scribed including the use of in-vitro techniques such as mammary tissue slices and homogenates, cell and gland cultures, and isolated perfused udders. The use of trained conscious ruminants with exteriorized blood vessels for measuring arterio-venous differences and blood flow is discussed. By using radioactive amino acids and measurement of arterio-venous differences, the uptake of essential and non-essential amino acids has been estimated. The uptake of plasma amino acids is sufficient to account for the synthesis of the major milk proteins. Studies of the metabolism of some amino acids to carbon dioxide and to other amino acids has been facilitated using labelled compounds. Labelled glucose has been used to prove the origin of lactose and to measure its contribution to carbon dioxide and milk fat glycerol. With isotopes, it has been shown that acetic acid is the major precursor of milk fatty acids up to and including palmitic acid, the longer-chain fatty acids originating from plasma triglycerides and free fatty acids. By using doubly labelled lipids, information has been obtained on the mechanism of uptake by the mammary gland. It is suggested that lactation work with goats could be undertaken in the tropics to provide data for comparing with results obtained in temperate climates. Research on lactation in buffaloes is proposed, possibly at a centre for buffalo research where many of the problems in buffalo breeding and nutrition could be studied. (auth)

29954 MINERAL AND TRACE MINERAL DISEASE STUDIES WITH TRACERS. Lengemann, F. W. (Cornell Univ., Ithaca, NY). pp 47-60 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

When animal agriculture changes from extensive to intensive production, problems can develop because local diets or feed materials are deficient in some minerals or contain excesses of others. Scientists in these countries will be called upon to identify the source of the problem and then to develop diets, based on local feedstuffs, that will provide a proper nutrient supply. This paper outlines some procedures utilizing radioisotopes that can be of use to such scientists in identifying mineral diseases and in the study of the requirements of the livestock for maximum production. Among the procedures discussed are neutron activation, in-vitro uptake of a particular radionuclide, the comparison of the absorption of an element from two different mineral sources, the measurement of true absorption by a double isotope procedure, the measurement of the endogenous fecal return of a mineral nutrient, the use of a reference substance to determine site of absorption and endogenous secretion, the use of models, and tracer studies using stable isotopes. (auth)

29955 ROLE OF TRACER TECHNIQUES IN ANIMAL NUTRITION IN INDIA. Ranjhan, S. K. (Indian Veterinary Research Inst., Izatnager). pp 61-71 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

Animal production in India is at a low level relative to that in some of the advanced countries. There are three basic reasons for this low productivity. The first is that the genetic potential of stock for the production of milk, meat, and eggs is low; secondly, there are deficiencies of feeds and fodder, and poor nutrition is a major limiting factor in production; and thirdly, diseases and other tropical environmental factors also limit production in the animals. In order to reduce the shortage of feeds and fodder in India, utilization of agro-industrial by-products is a major area of research in India. Studies on the utilization of urea as a protein supplement are urgently required and protection of protein by formaldehyde treatment should also be investigated. Experiments on the protection of protein, NPN utilization and liquid-diet feeding of urea and molasses are being done at the Indian Veterinary Research Institute. The improvement of nutritive value of straws with alkali treatment, the effect of the addition of sodium sulphite on the feed intake and nutrient utilization by cattle and buffaloes are also being studied. As part of these investigations, the fermentation patterns in the rumen are being measured by the use of radioisotope techniques. (auth)

29956 STUDIES ON ADAPTATION OF CATTLE TO TROPICAL ENVIRONMENTS AND THE ROLE OF RADIOISOTOPES. Vercoe, J. E. (Commonwealth Scientific and Industrial Research Organization, Rockhampton, Australia). pp 73-87 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

Animal production is the result of the interaction between the environment and the genotype. In tropical environments, productivity can be increased largely by deriving adapted genotypes and to some extent by modifying the environment. Tropical environments are characterized by high temperatures, humidity, parasites (internal and external), and by large seasonal variations in food quality and quantity. Cattle must be able to cope with these factors to survive, to be fertile, and produce fast growing calves. Some breeds can do this better than others and by cross-breeding and selection for production, high-producing adapted cattle can be derived. Empirical testing of the known combinations which are likely to increase productivity may not be feasible nor is a satisfactory outcome assured. Analyzing the physiological and biochemical processes involved in adaptation, and applying this knowledge to a selective breeding program using suitable indices of these processes, is an alternative which is likely to be more satisfactory in the long term. The aim is not to maximize the production of a particular genotype but rather to optimize and stabilize productivity within the limits of the environment. The interaction between three breed-types (Brahman × British, Africander × British, and British × British) and a tropical environment is described for fertility and growth rate, which are the main components of productivity. The major environmental factors responsible for the different productivities of the breed-types have been defined. Some indices which are correlated with the components of productivity under grazing conditions have been identified and the possible physiological, biochemical, and immunological factors that underlie them have been studied. These indices have been coat and skin characters or blood constituents. Under controlled conditions, the differential reactions of the breed-types to parasites and heat stress, and comparative studies of feed utilization of the three breed-types, with and without environmental stress factors, have been made. These have provided some reasons for the differences in growth rate of the different breeds under grazing conditions. Comparative body composition measurements have further highlighted the breed × environment interaction in productivity in this environment. Radioisotopes have played a part in the progress to date and their contribution in the future is expected to increase. This is not only because the comparative aspects of the project will possibly become more biochemically and immunologically centered but also because there is a large potential use for isotopes in identifying and measuring indices of productivity, e.g., concentration, pool size, and turnover rate of a particular blood constituent(s) or the changes in these parameters resulting from some stimulus. With this type of measurement, individuals could be ranked and used in selective breeding programs aimed at producing highly adapted and productive breed-types. (auth)

29957 TRACER STUDIES IN ENVIRONMENTAL ADAPTATION. Johnson, H. D. (Univ. of Missouri, Columbia). pp 89-100 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From Panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

The effects of short-term environmental heat exposure on non-acclimated cattle and long-term heat acclimation studies on the physiology of cattle by the use of tracer techniques are described. The physiological measures were energy metabolism, rectal temperature, vaporization, plasma growth hormone, prolactin and TSH disappearance rates (k), LH, cortisol, epinephrine, and norepinephrine. Short-term exposure to 39°C or higher environmental temperatures caused significant increases in all of these functions whereas long-term acclimation (29 to 35°C) resulted in significant declines of all these functions including milk production and feed intake; however, epinephrine and norepinephrine plasma values remained elevated. The possible relationship of these physiological changes to the phenomenon of acclimation or adaptation occurring in cattle in the tropics is discussed. (auth)

29958 EXPERIMENTAL SURGICAL TECHNIQUES FOR TRACER STUDIES IN DOMESTIC ANIMALS. Hill, K. J. (Unilever Research Lab., Shambrook, Eng.). pp 101-109 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

After a description of the basic animal requirements and facilities needed for the conduct of simple experimental surgery, the techniques of intravenous injection, venous catheterization, rumen fistulation, and carotid artery exteriorisation are given in detail. Some aspects of post-operative care are discussed and a representative list of references to the literature on the simpler surgical techniques is appended. (auth)

29959 RADIOACTIVE REFERENCE SUBSTANCES IN GASTRO-INTESTINAL STUDIES. von Engelhardt, W. (Univ., Stuttgart). pp 111-124 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

In recent years, non-absorbable markers have been increasingly used in studies of gastro-intestinal absorption, secretion, flow rate of digesta, retention time, and digestibility. Radioactive reference substances are easily analyzed and will be used with increasing frequency. Criteria for the ideal non-absorbable, inert marker substance are quoted, and several radioactive marker substances are reviewed briefly: (1) water-soluble markers (^{14}C- and ^{3}H-PEG, ^{51}Cr-EDTA, $^{51}CrCl_3$, ^{131}I- and ^{125}I-labelled substances, ^{60}Co-vitamin B_{12}, ^{14}C-inulin, and ^{14}C-mannitol); (2) water-insoluble markers ($^{51}Cr_2O_3$, ^{144}Ce, ^{91}Y, ^{103}Ru, ^{192}Ir, and $Ba^{35}SO_4$); (3) lipid-soluble markers. Advantages as well as limitations of marker techniques and of different substances are emphasized. (auth)

29960 ISOTOPIC TRACERS IN PROTEIN METABOLISM STUDIES IN RUMINANT PRODUCTION IN DEVELOPING COUNTRIES IN THE TROPICS. Leng, R. A. (Univ. of New England, Armidale, Australia). pp 125-132 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

The importance of the ability of ruminants to synthesize bacterial protein from non-protein nitrogen (NPN) sources in relation to the availability of roughages and agro-industrial by-products in tropical countries is emphasized. Techniques for measuring protein synthesis and volatile fatty acid production rates in the rumen as well as the flow of protein to the lower digestive tract, are presented. The application of these techniques in applied nutritional studies of protected proteins and the utilization of molasses and non-protein nitrogen is discussed. Studies of amino acid turnover, wool growth, and sulphur amino acid nutrition by means of isotopes are briefly mentioned, together with some specific applications in studying NPN supplementation in grazing ruminants. (auth)

29961 TRACER STUDIES ON THE INTERACTION BETWEEN PARASITISM AND ANIMAL PRODUCTION. Vercoe, J. E. (Commonwealth Scientific and Industrial Research Organization, Rockhampton, Australia). pp 133-141 of Tracer Techniques in Tropical Animal Production. Vienna; International Atomic Energy Agency (1974).

From panel on the use of nuclear techniques in some aspects of animal production in tropical climates; Jakarta, Indonesia (16 Oct 1972). See STI/PUB-360; CONF-7210115-.

The effect of some external and internal parasites on the growth rate of three breed-types of cattle grazing in a sub-tropical environment at Rockhampton, Australia, is described. Different breed-types react differently to different parasites. In the case of cattle tick (Boophilus microplus), Brahman × British cattle carry few ticks and the response in growth rate, when they are kept free of tick, is small. Africander × British cattle show a response when kept tick free, even though they carry relatively few ticks, but in British cattle (Shorthorn × Hereford), tick numbers are greater and there is a marked growth response. In the case of helminths, Brahman × British cattle apparently carry similar burdens to the Africander × British and British but are least affected by the parasites. Studies at various laboratories that have quantitated the effect of both external and internal parasites on some aspects of protein metabolism are described in detail, and the role of radioisotopes in labelling plasma albumin, plasma proteins, and red cells to facilitate these studies is emphasized. In tick studies, radioisotopes have enabled the uptake of plasma and red cells to be measured at various stages of tick's life-cycle, and other effects of tick on plasma protein components, body water and indirectly, body composition, to be estimated. In studies on the effect of helminths, radioisotopes have enabled quantitative assessments of intestinal bleeding, plasma leakage into the gastrointestinal tract, plasma volumes, plasma albumin turnover rates, and related measurements. In addition, the uses of radioisotopes to study some aspects of digestion and post-absorptive metabolism, particularly in helminth-infected sheep, are briefly mentioned. The role of radioisotopes in studies of parasitism and animal production, their strengths and limitations, is discussed. (auth)

29962 LYMPH NODE TEST FOR SILICOSIS BY ACTIVATION ANALYSIS COMBINED WITH SPECTROPHOTOMETRY. Ordogh, M.; Orban, E.; Miskovits, G.; Appel, J.; Szabo, E. (Inst. of Nuclear Physics, Budapest). Int. J. Appl. Radiat. Isotop.; 25: No. 2, 61-67 (Feb 1974).

A combined neutron activation and spectrophotometric analysis was developed for the reproducible determination of silicon in extremely small (10 to 80 mg) inhomogeneous lymph node samples. By this procedure aluminium and phosphorus are also determined simultaneously with silicon. The investigations covered lymph nodes lying far from the lung of coal-miners suffering from silicosis, as well as different type of lymph nodes from persons who had met with violent death but could be considered free of silicosis. It was found that the silicon content of lymph nodes is significantly higher in miners with diagnosed silicosis than in persons not exposed routinely to silicon dust, and that in the latter the silicon concentration varies with age. The silicon content of the bifurcational lymph node was correlated with that of the angulus venosus node, thus the easier accessibility of the latter makes it more convenient for routine analysis in clinical practice. (auth)

29963 ^{99m}Tc LABELLED ERYTHROCYTES FOR SPLEEN SCANNING. Smith, P. H. S. (Royal Marsden Hospital, London). Int. J. Appl. Radiat. Isotop.; 25: No. 3, 137-139(Mar 1974).

A simple solvent extraction method to obtain $^{99m}Tc\ O_4^-$ of the concentration necessary in a volume of 0·1 ml or less, a method of labeling red blood cells based on that of Eckelman et al (J. Nucl. Med.; 12: 22 (1971)), and the procedure used to damage the cells by heat treatment are presented. The method has been applied in examinations of 14 patients. ^{99m}Tc labeled cells were found particularly useful in accurately locating the spleen in patients referred for hematological investigations, including whole-body scanning utilizing ^{51}Cr labelled cells; the short half-life and low energy of the photons of the ^{99m}Tc reduces the problem of interference when subsequently measuring ^{51}Cr activity. (UK)

29964 INVESTIGATION OF ^{113m}In-INDIUM OXINATE AS A POSSIBLE LUNG-SCANNING AGENT. Scott, J. R.; Slysh, A.; Noujaim, A. A.; Wiebe, L. I.; Ediss, C. (Univ. of Alberta, Edmonton). Int. J. Appl. Radiat. Isotop.; 25: No. 3, 139-142(Mar 1974).

A rapid, simple method is described for the preparation of ^{113m}In-labeled indium oxinate particles. The radiopharmaceutical was evaluated as a potential lung-scanning agent by various animal studies including tissue distribution, organ scanning, toxicity, and whole-body counting. Over 90% of an intravenously administered dose in mice localized rapidly in the lungs. Lung scans performed on dogs afforded good visualization of pulmonary arterial capillary perfusion. (UK)

29965 IN VIVO RADIOIMMUNOASSAY OF ALDOSTERONE. Vecsei, P.; Gless, K. H.; Winter, M.; Hanka-Postozky, M. (Univ., Heidelberg). Acta Endocrinol.; 74: 307-315(1973).

Aldosterone antibodies were raised in sheep immunized with a complex of D-aldosterone-21-hemisuccinate and bovine serum albumin. The intravenous injection of these antibodies into rats caused a delay in the disappearance rate of tritiated aldosterone from the blood. The degree of this effect depends on the body weight of the animals, on the amount of the antiserum given, and on the interval between the injection of antibodies and that of labeled aldosterone. After the injection of aldosterone antibodies and the tritiated hormone, the plasma concentration of labeled aldosterone was related to the rate of secretion of the hormone. When aldosterone secretion was low, subsequent to high sodium intake, or abolished after adrenalectomy, the plasma concentration tritiated aldosterone was higher than in the control rats. Stimulation of aldosterone secretion by furosemide or ACTH, or administration of cold aldosterone resulted in a decrease in the plasma concentration of the labeled hormone. It is suggested that the relationship between the amount of free aldosterone in the inner pool and the plasma concentration of tritiated aldosterone is the consequence of a competition of labeled and unlabeled hormone for the binding capacity of the antibody. (auth)

29966 USE OF A WHOLE-BODY COUNTER FOR MEASURING BONE MARROW ERYTHROID ACTIVITY BY PROFILE SCANNING. Davies, I. H.; Jacobs, A.; Owen, G. M. (Welsh National School of Medicine, Cardiff). Int. J. Nucl. Med. Biol.; 1: No. 3, 145-147(Feb 1974).

Profile scanning was used to determine the distribution of ^{59}Fe within the body, as an assessment of bone marrow ability to produce red cells. A brief description is presented of the adaptation of a whole-body counter with scanning bed geometry, by the addition of slit collimators to two detectors. A measure of bone marrow erythroid activity was made by estimating radioiron in the pelvic region 21 hr. after intravenous injection of ^{59}Fe. In 11 normal subjects, the pelvic erythroid activity ranged from 38 to 48%, while the 14-day red cell iron utilization ranged from 81 to 100%. In one case each of myelosclerosis, red cell aplasia, and acute myeloblastic leukemia, there was insignificant pelvic marrow uptake. In two cases each of disseminated carcinoma and Hodgkin's disease, one case of iron deficiency anaemia and one of chronic lymphatic leukemia, the pelvic fraction varied between 16 and 43%. (UK)

MATERIALS

29967 (CNLM-3896) SUMMARY OF NUCLEAR FUELS AND MATERIALS DEVELOPMENT, CALENDAR YEAR 1961. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 16 Nov 1961. Contract AT(30-1)-2789. 46p. Dep. NTIS $5.50.

Declassified 18 Sep 1973.

Research reported include uranium carbide R & D (synthesis, fabrication, irradiation, U_2C_3 formation, Li corrosion, alloying, analysis); uranium nitride production and evaluation; alloy development (oxidation resistance and strength of Nb alloys); coating development (Ti–Si–Cr, Al–Cr–Si, Ti–Al–Si); and alkali metals (Li). (27 figures) (DLC)

29968 (CNLM-5261) MATERIALS TASKS FOR LCRE, SNAP-50/SPUR, AND ADVANCED MATERIALS PROGRAMS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 27 Sep 1963. Contract AT(30-1)-2789. 136p. Dep. NTIS $9.00.

Declassified 30 Aug 1973.

125 figures are included which were presented at the Materials Review Meeting for the LCRE, SNAP-50/SPUR, and Advanced Materials programs, held at CANEL on Sept. 18 and 19, 1963. Fuels, structural materials, alkali metal coolants, and auxiliary materials are included. (DLC)

29969 (JUL-1035-FF) DETERMINATION OF THE PHONON SPECTRUM FROM COHERENT INELASTIC NEUTRON SCATTERING BY POLYCRYSTALS. Breuer, N. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Dec 1973. 95p. Dep. NTIS (U. S. Sales Only) $7.75.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

An analytical investigation of the accuracy of Bredov's approximation was made to estimate the order of magnitude and cause of the errors involved. Bredov's approximate spectrum was compared with the exact spectrum for those properties of the exact spectrum which could be calculated analytically. It was found that there can be considerable errors between Bredov's approximation and specific properties, especially if the number of the corresponding critical points per Brillouin zone is small; with respect to integral properties, however, Bredov's spectrum agrees with the exact spectrum to about 10%. Even though the simplest lattice model was used, the errors are expected to change drastically; indeed, the approximation should become more accurate in the high-frequency range. (DLC)

29970 STABILITY INCREASE FOR EMISSION CHARACTERISTICS OF CATHODES OPERATING UNDER CONDITIONS OF NUCLEAR RADIATION AT HIGH TEMPERATURES. Geichenko, V. V.; Isaichev, V. I.; Larikov, L. N.; Nosar, A. I.; Shaldervan, P. I. (Inst. of Metal Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 9, 1435-1438(Sep 1973). (In Russian).

The problem is considered for providing stable surface emission properties of cathodes operating at high temperatures under conditions of nuclear radiation. It is shown that the change in impurity atom concentration on the cathode surface induced by transmutation and diffusion from the volume may be either reduced to zero or considerably decreased by a preliminary injection of the impurity atoms into the cathode body with a definite law of the concentration change. (auth)

29971 SOLID STATE PHYSICS. Advances in Research and Applications. Volume 28. Ehrenreich, H.; Seitz, F.; Turnbull, D. (eds.). New York; Academic Press, Inc. (1973). 440p.

Four articles are included: lattice and electronic properties of intermetallic compounds possessing the A-15(β–W) structure; electronic structure of PbS, PbSe, and PbTe; density-functional formalism and electronic structure of metal surfaces; and elastic scattering of low-energy electrons from surfaces. Author and subject indexes are included, together with a cumulative author index for Volumes 1 through 28. (DLC)

29972 ANALYTIC SOLUTION FOR THE BOUND-STATE WAVE FUNCTIONS OF THE EXPONENTIALLY SCREENED COULOMB POTENTIAL. Nauenberg, M. (Univ. of California, Santa Cruz). Phys. Rev., A; 8: No. 5, 2217-2219(Nov 1973).

A new method is described to obtain a sequence of wave functions and energy eigenvalues which converge rapidly to the exact bound state of the Schroedinger equation for the exponentially screened Coulomb potential. (auth)

29973 OXIDATION OF REFRACTORY COMPOUNDS. II. Voitovich, R. F.; Pugach, E. A. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 43-49(Feb 1974). (In Russian).

High-temperature oxidation of VSi_2, $NbSi_2$, and $TiSi_2$ was studied in the temperature range of 500 to 1200°C in air. The formation of multilayer multiphase scales consisting of silicon oxides, lower metal silicides, metal oxides, gaseous SiO, and corresponding metal nitrides is established to be a peculiar feature for the oxidation process of the V group metal disilicides. (auth)

29974 TEPLOFIZICHESKIE SVOISTVA TVERDYKH VESHCHESTV. (Thermophysical Properties of Solids). Samsonov, G. V. (ed.). Moscow; Izdatel'stvo Nauka (1973). 161p.

The publication contains thirty articles dealing with thermodynamic and thermophysical properties of ceramics and metals. Five articles were selected for inclusion in NSA. (SFC)

For abstracts of individual papers see: 30036–30038, 30143, and 30144.

Ceramics and Cermets

Refer also to abstracts 29043, 29081, 30958, 31205, 31302, and 31652.

29975 (AD-766768-6) INVESTIGATION OF THE ABSORPTION COEFFICIENT OF NEUTRON IRRADIATED SILICON DOPED WITH Li OR Cu. Final Report, 15 September 1971–30 June 1973. Chen, C. S.; Corelli, J. C. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). 1 Jul 1973. Contract F19628-72-C-0032. 71p. (AFCRL-TR-73-431). NTIS $3.50.

Infrared spectroscopy studies of Li, and Cu-doped and Li-B compensated irradiated Si are reported. In Li-containing Si, divacancy-associated bands and several new bands were observed which are associated with at least three different defect complexes in which lithium impurities are directly involved. The production and recovery of divacancies depend strongly upon the Li concentration. Simple lithium-associated defects, such as the Li-vacancy, are also produced during irradiation whose dissociation enhances the concentration of other Li-associated defect complexes. In Li-B compensated Si, several new absorption bands and a huge near-edge absorption are observed accompanied by a decrease in the Li-B vibrational bands during irradiation. The near-edge absorption depends not only on the neutron fluence but also on the number of Li-B pairs which play an important role in the formation of defect complexes. No Cu-associated band is observed before or after irradiation of the Cu diffused samples. The presence of Cu impurities in Si does not affect the production of the divacancy, implying no interaction of Cu with radiation-induced defects. (GRA)

29976 (AD-768789-0-GA) INFLUENCE OF SOME SPECIFIC ADDITIVES ON THE STRENGTH OF PRESSURE-SINTERED BERYLLIA. Greenspan, J. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). May 1973. 14p. (AMMRC-TR-73-25). NTIS $2.75.

An exploratory survey was conducted on the influence of some specific additives of MgO, Al_2O_3, and SiC, to BeO with respect to pressure sintering processing, and with respect to strength development. Highest strengths were represented by BeO–Al_2O_3 binaries of very fine grain size and dense microstructures. (GRA)

29977 (AECL-4443) URANIUM CARBIDE FUEL FOR ORGANIC COOLED REACTORS. Jones, R. W.; Crosthwaite, J. L. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Dec 1973. 47p. Dep. NTIS (U. S. Sales Only) $5.50. AECL $1.50.

A survey of the available irradiation experience with uranium carbide is presented, with particular emphasis on use as fuel for organic-cooled power reactors. The satisfactory behavior of hyperstoichiometric UC under organic-cooled reactor conditions was demonstrated to burnups in excess of 400 MWh/kgU at element power outputs up to 90 kW/m and cladding temperatures approaching 500°C. Satisfactory performance at ratings above 100 kW/m and burnups of 250 MWh/kgU seems probable. (5 figures, 49 references) (auth)

29978 (CNLM-3160) FUELED BeO FOR NUCLEAR REACTORS. Dytko, E. R.; Kuhns, R. M. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 25 Nov 1960. Contract AT(11-1)-229. 23p. Dep. NTIS $4.25.

Declassified 17 Sep 1973.

Fuel pins containing UO_2–65 vol % BeO pellets are to be used in a Li-cooled high intermediate spectrum reactor for aircraft use. The irradiation performance of the fuel element is described. (15 figures) (DLC)

29979 (CNLM-3901) SUMMARY OF RECENT NUCLEAR FUELS RESEARCH AND DEVELOPMENT AT CANEL. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 21 Nov 1961. Contract AT(30-1)-2789. 31p. Dep. NTIS $4.75.

Declassified 18 Sep 1973.

Research on uranium carbide included synthesis, fabrication, irradiation, formation of U_2C_3, Li corrosion, alloying with ZrC and W, and chemical analysis. For uranium nitride, work was done on synthesis and fabrication of Nb cermets, and evaluation. (DLC)

29980 (CNLM-4311) SUMMARY OF RECENT URANIUM NITRIDE FUEL RESEARCH AND DEVELOPMENT. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 9 Nov 1962. Contract AT(30-1)-2789. 19p. Dep. NTIS $4.00.

Declassified 18 Sep 1973.

Uranium nitride was developed as a high-temperature fuel for liquid metal-cooled reactors. The development included fabrication studies, environmental compatibility, thermal stability, hot hardness, and irradiation testing. Besides pure UN, mixtures of UN and ZrN were also investigated. (DLC)

29981 (CONF-740414-1) MATERIALS STUDIES IN SUPPORT OF LIQUID METAL MHD SYSTEMS. Tuohig, W. D.; Roberts, J. T. A.; Singh, R. N. (Argonne National Lab., Ill. (USA)). 1974. 8p. Dep. NTIS $3.00.

From 14th symposium on engineering aspects of magnetohydrodynamics; Tullahoma, Tennessee, USA (8 Apr 1974).

Materials suitable for use in the construction of a high-temperature liquid-metal MHD demonstration generator are identified. The alkali metals, in particular sodium and lithium, are attractive for use as the conductive fluid because of high realizable conversion efficiencies; they are, however, extremely corrosive, particularly at elevated temperatures. The most severe materials problem to be resolved is that of insulator compatibility with the molten alkali metals. Preliminary screening studies of candidate ceramic insulators are qualitatively discussed in terms of generator design requirements. (auth)

29982 (EUR-5078) SELF-DIFFUSION OF URANIUM IN URANIUM MONOCARBIDE-EVALUATION OF CURVED ARRHENIUS DIAGRAMS. Matzke, H.; Tasman, H. A. (Commission of the European Communities, Karlsruhe (F. R. Germany). European Inst. for Transuranium Elements). Feb 1974. 50p. Dep. NTIS (U. S. Sales Only) $5.50. EUR B. Fr. 70.-.

A curved Arrhenius plot was observed for uranium diffusion in stoichiometric UC. The equation for the diffusion of U in UC is $D = 6.9 \exp(-141{,}000/RT) + 3.6 \times 10^{-5} \exp(-84{,}500/RT)$ $cm^2 sec^{-1}$. These results are discussed on basis of the present knowledge of nontrivial curved Arrhenius diagrams (so far observed mainly for metals, alkali metal halides, and silver halides). Different possible mechanisms are discussed. As plausible reason for the curvature, a single vacancy mechanism is suggested at low temperatures, whereas a divacancy mechanism is said to dominate at temperatures near the melting point (2085–2545°C). As most probable alternative, the effect of impurities by providing impurity-vacancy interactions is suggested. Finally, the evaluation procedure was applied to curved Arrhenius plots on other systems that were reported in the literature. (8 tables, 26 figures, 44 references) (DLC)

29983 (GA-4022(Pt.2)) ADVANCED, GRAPHITE-MATRIX, DISPERSION-TYPE FUEL SYSTEMS. First Annual Report, April 1, 1962–March 31, 1963. Goeddel, W. V.; Sandefur, N. L.; White, J. L. (General Dynamics Corp., San Diego, Calif. (USA). General Atomic Div.). 1 May 1963. Contract AT(04-3)-167. 42p. Dep. NTIS $4.25.

Declassified 4 Sep 1973.

A hot-working device for compression of graphite bodies was used to deform cylindrical specimens of matrix graphite containing ZrC or UC–ZrC particles to strains of the order of 30% at temperatures of 2400 to 2900°C. The graphite bodies containing ZrC particles (chosen as representative carbide particles) were found to be more plastic near 2500°C than similar bodies containing no carbide particles. Microradiographic techniques were used to determine diffusion coefficients of U and Th on actual coated particles by nondestructive means. A tentative energy of activation for the migration of uranium from UC_2 particles into PyC coatings was determined over the temperature range 1850 to 2300°C. The penetration of U into the coatings is not uniform but occurs radially in localized positions, and then spreads circumferentially, creating a banded structure. These results show the importance of the structure of PyC in regard to the diffusion of both fuel and fission-product materials. It was also observed that the diffusion of U is considerably more rapid in the direction parallel to the layer planes in the PyC than it is in the perpendicular direction. Tests with PyC-coated (U, Zr)C particles in graphite-matrix compacts showed that the addition of Zr to the uranium carbide greatly improves the thermal stability. In general, the coatings on these particles retained their integrity for several hours at 2300 and 2500°C. (29 figs) (DLC)

29984 (GEMP-10-B) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 10, PART B. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 16 Apr 1962. Contract AT(40-1)-2847. 54p. Dep. NTIS $4.75.

Declassified 21 Sep 1973.

Six items are reported: evaluation of developed ceramic fuel elements (BeO + UO_2–Y_2O_3), coatings of Y_2O_3–ZrO_2, coated fuel particle development and evaluation, $UO_{2.9} \cdot 3Y_2O_3$ fuel materials and properties, stabilization of UO_2 in ceramic fuel elements, and fission product migration in solids. (DLC)

29985 (GEMP-518) RECENT DEVELOPMENTS IN METALLIC HYDRIDE SHIELDING MATERIALS. Van Houten, R. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 22 May 1967. 41p. Dep. NTIS $4.25.

Declassified 21 Sep 1973.

A wide range of metallic hydrides (to N_H 9.0), each containing additives to tailor the nuclear characteristics, have been fabricated successfully. Specific additives have included B compounds and high Z-material compounds, e.g., W, Hf, Th. Hydrided Ti which contains B compounds has proven relatively easy to fabricate and has shown excellent radiation stability. Post-irradiation appearance (through 6×10^{20} nvt thermal) shows no visible changes. Strengths to 150,000 psi at 380°C (with ductile failure) have been observed for TiH. Sound, massive N_H 6.9 hydrided Zr rods have been fabricated in hydride-furnace batches as large as 50 kg, with 100% yield. A 50 Th–50 Zr hydride of N_H 6.7 and higher has been fabricated. The basic structure, apparently $ThZr_2H_3$, is a cubic spinel-type structure and is the first reported hydride having this structure. This material, when containing a B compound additive, will probably provide more gamma shielding than is generally needed, but the material has interesting possibilities as a combination breeder-blanket-shield. It now appears that almost any combination of looked-for nuclear properties can be incorporated into a metallic hydride composite having useful engineering characteristics. (16 tables, 23 figs) (DLC)

29986 (GEMP-635) FISSION PRODUCT BEHAVIOR WITHIN TWO W–UO_2 CERMET FUEL ELEMENTS IRRADIATED IN A TEMPERATURE GRADIENT. Seifert, D. A.; Stuart, R. L.; Conn, P. K.; McLaughlin, H. W.; Luersen, G. J. (General Electric Co., Cincinnati, Ohio (USA). Missile and Space Div.). Aug 1968. Contract AT(40-1)-2847. 37p. Dep. NTIS $4.00.

Declassified 21 Sep 1973.

Two W–UO_2–ThO_2 cermet fuel specimens, one clad with T-111 and the other with W–Re–Mo, were studied to determine the retention, distribution, and mobility of fission gas in cermet core fuel systems. The T-111- and W–Re–Mo-clad specimens, irradiated for 5000 h to peak burnups of 5.6×10^{19} and 5.0×10^{19} fissions/cm^3 with temperature ranges of 530 to 1400°C and 770 to 1550°C, respectively, were gamma scanned and then punctured; fission gases were collected and analyzed for ^{85}Kr. Thin transverse sections at various positions along the length were analyzed for ^{85}Kr and ^{137}Cs contents in the ceramic fuel and W matrix phases. Inventories and distributions of ^{137}Cs and ^{85}Kr between the UO_2 and and W phases were obtained as a function of temperature. Results showed that 90 to 95% of the total fission gas inventories were either dissolved in the UO_2 and W lattices or trapped in closed pores. The remaining 5 to 10% of the gases were mobile and free to migrate through channels between the fuel and matrix phases. 15 to 20% of the fission products recoiled into the W matrix and were essentially immobile under the experimental conditions. The gas which was free to migrate was released only from the fuel phase; gas release was negligible below about 650 to 700°C, and at 1550°C amounted to about 20% of that produced in that temperature region of the specimen. ^{137}Cs was quantitatively retained by both the fuel and matrix phase for the conditions of these tests and, therefore, did not contribute to the amount of mobile gas. (10 figures, 3 tables) (DLC)

29987 (KFK-1910) SYSTEM URANIUM OXIDE–EUROPIUM OXIDE–OXYGEN. Tanamas, R. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Radiochemie). Dec 1973. 84p. (In German). Dep. NTIS (U.S Sales Only) $7.25.

Thesis. Submitted to Karlsruhe Univ. (West Germany). Faculty fuer Chemie.

The phase diagram of the UO_2–$EuO_{1.5}$–oxygen system at 1250°C was established by means of x-ray diffraction and electrochemical methods. Besides the oxides of the binary metal–oxygen systems, only three distinct ternary phases were observed:

a cubic fluorite phase $(Eu,U)O_{2+x}$, a cubic C–$(Eu,U)O_{1.5+x}$-phase, and a rhombohedral phase ranging from $UO_3 \cdot 6EuO_{1.5}$ to $UO_2 \cdot 2EuO_{1.5}$ as the limiting compositions. Emf measurements with a high-temperature galvanic cell show that in the temperature region 800 to 1050°C the cubic C–$EuO_{1.5}$ is the stable modification of europium sesquioxide from the thermodynamic point of view. It transforms to B–$EuO_{1.5}$ at 1050 ± 20°C. By the incorporation of UO_{2+x} ($x < 0.3$), C–$EuO_{1.5}$ can also be stabilized at higher temperatures to at least,1250°C. No solubility of UO_{2+x} in B–$EuO_{1.5}$ exists which is understandable by the very different molar free energies for the solubility of oxygen in the different $EuO_{1.5}$ modifications. (30 figs, 16 tables) (auth)

29988 (LA-4308) DEVELOPMENT OF PARTICLES COATED WITH PYROLYTIC CARBON. VIII. Improved Core-coat Combinations. Bard, R. J.; Baxman, H. R.; Bertino, J. P.; Hayter, S. W.; O'Rourke, J. A.; McCreary, W. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1969. Contract W-7405-eng-36. 52p. Dep. NTIS $4.75.

Declassified 28 Aug 1973.

Pyrolytic-carbon-coated UO_2 particles with improved stability at 2500°C or higher temperatures were developed for fuel elements for Rover reactors. Single-layer and two-layer coatings of various types were studied on a variety of General Atomic UC_2 cores with a complete graphite shell. Particles with nominal 40-μ-thick coatings on 104- to 147-μ dia cores and with nominal 50-μ-thick coatings on 124- to 175-μ-dia cores were prepared and tested. The work resulted in progressive improvement of thermal stability as coatings with improved capability for containment of melt were developed and higher quality General Atomic UC_2 cores became available. The best coating for melt containment was a two-layer coating with an inner, sacrificial layer of high-density, isotropic pyrolytic carbon and an outer, migration-resistant layer of high-density, oriented pyrolytic carbon having a smooth microstructure. The outer layer was reorganized to a substantially higher density and preferred orientation by pretreating at 2300°C for 4 h, whereas the inner layer was changed very little. In subsequent testing at 2500°C or above, the inner layer apparently served as a concentrated source of carbon atoms in an imperfect crystal structure that preferentially went into solution in melt leaking through the graphite shells on the cores and temporarily protected the outer layer during further reorganization. The best particles, with nominal 40-μ-thick, two-layer coatings of this type on the best 104- to 147-μ-dia General Atomic experimental UC_2 cores, had the following percentages of uranium exposed to leaching with hot HNO_3 solution after single 30-min tests following pretreatment at 2300°C for 4 h and cooling: <0.2% at 2500°C, <0.5% at 2600°C, <2% at 2700°C, and <3% at 2800°C. Such particles had up to 5 or 8% of their uranium exposed when subjected to cyclic testing with three 30-min periods at 2500 or 2600°C, respectively. In the 90-min, three-cycle tests, the effect of time was more important than the effect of cycling. (31 tables, 11 figures) (auth)

29989 (PWAC-431) STATUS OF THE SNAP-50 REACTOR FUELS PARAMETRIC STUDIES. Part I. Banach, H. B.; Richings, H. J. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 4 Mar 1964. Contract AT(30-1)-2789. 49p. Dep. NTIS $5.50.

Declassified 6 Sep 1973.

Results of the parametric study are given for both present and advanced capability (2 and 8 MW). Fuels which result in minimum reactor weights are UC/UN (95% dense), UC/UN–1W for the 2 MW design, UC/UN–1W for 8 MW. Effects of fuel clad and fuel maximum temperature on the reactor weight were also studied. Recommendations are made for the 2-MW SNAP-50/SPUR fuel element development and reactor design program, and for additional parametric studies. (DLC)

29990 (PWAC-488) URANIUM NITRIDE FUEL DEVELOPMENT, SNAP-50. DeCrescente, M. A.; Freed, M. S.; Caplow, S. D. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). Oct 1965. Contract AT(30-1)-2789. 116p. Dep. NTIS $8.00.

Declassified 12 Sep 1973.

Development of UN in four major areas is presented: 1) powder synthesis and powder metallurgical fabrication, 2) physical and mechanical property testing, 3) fuel-cladding compatibility and barrier development, and 4) irradiation evaluation. Synthesis and sintering methods for producing large quantities of high-density and high-purity UN are described. Results of experimental studies of the following properties are summarized: melting point, thermal conductivity, thermal expansion, vapor pressure, and thermodynamics, heat capacity, hot hardness, compressive creep, nitrogen self-diffusion, and electrical resistivity. Compatibility tests are described which demonstrated the need for a diffusion barrier. Lithium soak tests for up to 11,000 h at 2200°F demonstrated the stability and practicality of vapor-deposited tungsten-lined Nb–1 Zr alloy over the projected life and temperature of SNAP-50. Similar static tests of purposely defected simulated fuel pins indicate a relatively high degree of stability of UN towards lithium. Instrumented capsule irradiation tests of simulated Nb–1 Zr alloy clad fuel pins are described under 2 Mw(t) and 8 Mw(t) SNAP-50 conditions. Under 8 Mw(t) conditions, 20% fission gas release and 2% diametral cladding growth were observed after 2750 h at 2200°F (2.0 at. % U burnup). In-pile operation under 2 Mw(t) conditions was achieved for 5940 h at 2000°F (1.0 at. % U burnup) and 3360 h at 2200°F (1.5 at. % U burnup) while experiencing less than 0.2% fission gas release and less than 0.4% diametral growth. (66 figures) (auth)

29991 PREPARATION OF FREE-STANDING FILMS OF ANODIC TANTALUM OXIDE. Phillips, D. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Instrum. Methods; 116: No. 1, 195-196(1974).

Free-standing films of anodic tantalum oxide have been prepared by dissolving the underlying metal electrochemically. The homogeneity, uniformity and composition of the films are confirmed by Rutherford scattering. (auth)

29992 THERMAL CONDUCTIVITY OF FUEL ELEMENTS. II. Mixed Oxides. Chamero Ferrer, A.; Gispert Benach, M. Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 17: No. 86, 427-435(1973). (In Spanish).

In a continuation of the review of the published studies to resolve the problems presented by the determination of the thermal conductivity of fuel elements, the most significant data on the thermal conductivity of mixed oxides of U and Pu are presented. A brief review is made of other types of fuels (mixed U and Pu carbides and mixed U and Th oxides). (9 figures, 25 references) (tr-auth)

29993 THERMAL EXPANSION AT LOW TEMPERATURES OF UO_2 AND UO_2–ThO_2. White, G. K.; Sheard, F. W. (National Standard Lab., Sydney). J. Low Temp. Phys.; 14: No. 5/6, 445-457(Mar 1974).

Measurements of the linear coefficient of thermal expansion of UO_2 from 1.5 to 35°K show a first-order magnetic transition at T_N = 30.36°K (single crystal) and 30.40°K (sintered compact) with an associated strain $\Delta l/l \cong 25 \times 10^{-6}$. Comparison of the magnetic contributions to thermal expansion and heat capacity leads to a magnetic Grueneisen parameter $\gamma_m \cong 4$ ($T < 35$°K). Addition of ThO_2 reduces T_N to 24.0°K (10% ThO_2), 17.5°K (20%), 14°K (25%). For more than 25% ThO_2, the transition is broadened, but a very significant magnetic contribution to the thermal expansion remains up to 80% ThO_2. Broadened transitions are also found in specimens of UO_2 containing 8% and 20% ZrO_2. Variation of T_N with concentration is not in accord with theoretical models based on Heisenberg or Ising exchange interactions. A dilute sample containing 10% UO_2–90% ThO_2 has a negative expansion coefficient below 8°K, with a minimum at ~3°K. This may be associated with a Jahn–Teller splitting of the U^{4+} ionic states and qualitatively supports the theory of the first-order transition proposed by Allen. (31 references, 5 fig) (auth)

29994 LUMINESCENCE OF SECONDARY URANIUM MINERALS AT LOW TEMPERATURES. Gorobets, B. S.; Sidorenko, G. A. At. Energ. (USSR); 36: No. 1, 6-13(Jan 1974). (In Russian).

The following classes of uranium minerals and their synthetic analogues have been studied: a) phosphates and arsenates, b) silicates, c) carbonates and sulfate-carbonates, d) sulfates, e) vanadates, f) molybdates and g) hydroxides. Their spectra of luminescence (SL) at 77 and 298°K have been determined. At 298°K the minerals of classes e to g are not luminescent. In all SL, at 77°K, there are observed equidistant lines of symmetric vibration of uranyl, and for uranium micas often also lines of antisymmetric vibration. The role of specific forms of water participating in various uranium aqua-centers of luminescence in autunites has been investigated. Minerals manifesting bright luminescence at 298°K are characterized by a vibrational constant between 800 and 840 cm^{-1}. Its value decreases to 700 to 770 cm^{-1} for minerals having no luminescence at 298°K (classes e to g) and those having only faint luminescence (classes b and d). The SL at 77°K assures fast and reliable identification of minerals in most cases. (tr-auth)

29995 IMPROVEMENTS IN OR RELATING TO ROTARY KILNS. Gillies, G. M.; Littlechild, J. E. (to United Kingdom Atomic Energy Authority). British Patent 1,341,379. 19 Dec 1973. Filed date 23 Apr 1970. 25p.

An improved form of rotary kiln is described for carrying out gas–solids reactions. An example of its application is in the conversion of UF_6 to UO_2 by an integrated process in which

the UF_6 is reacted with steam to produce UO_2F_2 and the latter is then further reacted with steam and/or H_2 to produce the UO_2. (UK)

29996 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF CERIA. Woodhead, J. L. (to United Kingdom Atomic Energy Authority). British Patent 1,342,893. 3 Jan 1974. Filed date 10 Feb 1970. 8p.

CeO_2 has usually been prepared by calcination of the oxalate or hydroxide, but the normal method gives little control over the density or crystallite size. The primary object of the process described is to enable such control to be exercised. Ce(IV) hydroxide is first prepared in the manner described, and formed into a slurry with water and HNO_3. The slurry is then heated until the pH reached a steady value of <5.4, then dried to give a dry gel powder. The proportion of HNO_3 used controls the properties of the final product, and the relationship between the HNO_3/CeO_2 ratio, the initial pH and the final pH is shown in tabular form. Spray drying is preferred for the slurry. The gel powder is fired at about 950°C. It is emphasized that the process depends critically on the use of HNO_3 and that other common acids are not suitable. The gel is finally calcined to dry CeO_2. Several examples of application of the process are described, including the production of CeO_2 spheres. (UK)

29997 EFFECTS OF SiC ON MECHANICAL PROPERTIES OF A WC–6% Co CEMENTED ALLOY. Choi, H. S.; Yoon, Y. K.; Eun, K. Y.; Park, W. K. J. Korean Inst. Metals; 11: No. 2, 153-157(1973).

Effects of addition of SiC to a WC–6% Co alloy on mechanical properties of the cemented alloy were investigated. The addition of SiC was made to the cemented alloy as a solid solution of WC–SiC. The cemented alloy containing less than 1% SiC showed good densification, and the transverse rupture strength of the alloy was increased considerably at the SiC content of 0.5% whereas the hardness of the alloy was decreased slightly. It is believed that the addition of SiC inhibited decarburization of WC which always occurs during the sintering process and contributed to the strengthening of the cemented alloy. (Korean Sci. Abstr.)

29998 INVESTIGATION OF THE BENDING STRENGTH OF DISPERSIVE MATERIALS OF URANIUM DIOXIDE AND MOLYBDENUM IN THE TEMPERATURE INTERVAL 293 TO 1870°K. Kakushadze, L. E.; Kotel'nikov, R. B. At. Energ. (USSR); 36: No. 1, 19-23(Jan 1974). (In Russian).

The bending strength of hot-pressed cermets of molybdenum-coated uranium dioxide particles (–351 + 215μ) and of a mixture of similar uranium dioxide particles with molybdenum (5 to 20% of molybdenum volume) has been investigated in the temperature interval 293 to 1870°K. It has been established that the strength of cermets of coated particles is 20 to 100% greater than that of cermets of the mixture in the temperature interval and at the molybdenum concentrations investigated. Both types of cermets increase in strength with temperature and molybdenum concentration in the temperature interval 293 to 1500°K. With increasing temperature from 1500 to 1800°K, the strength of cermets with 5 and 10% of molybdenum continues to increase, and with 15 and 20% decreases. (tr-auth)

29999 STUDY OF THE KINETICS OF ZIRCONIUM OXIDE TRANSFORMATION BY X-RAY DIFFRACTION IN A TEMPERATURE CHAMBER. Perez, C. M. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 17: No. 86, 417-425(1973). (In Spanish).

In order to determine the solid state phase diagram of ZrO_2 a high temperature chamber for x-ray diffraction was developed. Its temperature control is described. The existence of the monoclinic and tetragonal phases of pure ZrO_2 and ZrO_2 from Zircaloy 2 is established. The kinetics of the monoclinic-tetragonal phase conversion and its reverse are studied by measurement of the $[11\bar{1}]$ and [111] crystallographic planes of the monoclinic phase and by the [111] plane of the tetragonal phase. (tr-auth)

30000 IRRADIATION EXPERIMENT FOR THE OPTIMIZATION OF MATERIAL PROPERTIES AND COATING THICKNESS OF COATED FUEL PARTICLES. Gyarmati, E. (Kernforschungsanlage, Juelich, Ger.); Baier, J.; Thiele, B.; Rotterdam, R.; Vygen, P. pp 432-435 of Reactor Meeting. Section 2. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). (In German).

Within the framework of the HTR fuel element testing in the reactor BR2-Mol, irradiation experiments have been carried out on coated fuel particles, in which the properties, structure, and geometry of the coatings were varied systematically. The purpose of these tests was to determine the effect of these parameters on the irradiation behavior of the particles. (GE)

30001 SPECTROSCOPIC STUDIES IN SOLID-STATE CHEMISTRY. Part 8. NQR Investigations on Rhenium(VII) Oxide Re_2O_7. Burkert, P. K.; Eckel, M. F (Technische Univ., Munich). Z. Naturforsch.; 28B: No. 9-10, 570-572(Oct 1973). (In German).

A strong asymmetry in the electronic charge distribution on the central metal of Re_2O_7 is caused by bridging oxygen atoms. This asymmetry is measured by determining the ^{185}Re, ^{187}Re–NQR transitions, NQR coupling constants and asymmetry parameter. (GE)

30002 VISCOSITY OF MOLTEN URANIUM DIOXIDE. Woodley, R. E. (Westinghouse Hanford Co., Richland, WA). J. Nucl. Mater.; 50: No. 1, 103-106(Feb 1974).

Measurements were made in an oscillating-cup viscosimeter at 2870 to 3030°C. Results in general confirm the results of Tsai and Olander (J. Nucl. Mater. 44:83 (1972)) as opposed to the high values of Nelson. The temperature dependence follow the relationship eta (cP) = 0.988 exp (4620/T°K). (DLC)

30003 PROPERTIES OF LENTICULAR PORES IN UO_2, (U, Pu)O_2, AND PuO_2. Ronchi, C.; Sari, C. (EURATOM, Karlsruhe, Ger.). J. Nucl. Mater.; 50: No. 1, 91-97(Feb 1974).

Lenticular pore migration rates in oxide nuclear fuels were measured in out-of-pile heating experiments. It is deduced that those pores which are in part responsible for the formation of columnar grains, are only produced in the absence of relevant amounts of filling gas. Specimens containing important concentrations of He, produced by Pu alpha decay, show columnar grain restructuring by grain boundary migration. Some consequences are drawn concerning the possible role played by lenticular pores in the mechanisms of fission gas release from nuclear fuels. (5 figures) (auth)

30004 THERMODYNAMIC AND PHASE BEHAVIOR IN THE U–Rh–C SYSTEM. Naraine, M. G.; Bell, H. B. (Univ. of Strathclyde, Glasgow). J. Nucl. Mater.; 50: No. 1, 83-90(Feb 1974).

A galvanic cell using a single crystal of CaF_2 as electrolyte was used to measure the free energy of formation of the compounds occurring in the U–Rh–C system. Arc-melted samples were subjected to varying annealing conditions; then metallographic and electron probe micro-analysis were used for phase identification. In the binary U–Rh system five compounds were found: URh_3, U_3Rh_5, U_3Rh_4, URh, and U_2Rh. The free energies of formation were: $\Delta G_f^0(URh_3) = -282.44 + 0.108$TkJ/mol, $\Delta G_f^0(U_3Rh_5) = -623.02 + 0.252$TkJ/mol, $\Delta G_f^0(U_3Rh_4) = -547.69 + 0.226$TkJ/mol, $\Delta G_f^0(URh) = -152.81 + 0.0672$TkJ/mol, $\Delta G_f^0(U_2RhC_2) = -303.38 + 0.0329$TkJ/mol, all for the range 1000-1200°K and $\Delta G_f^0(U_2Rh) = 182.08 + 0.085$TkJ/mol for 893-978 K. However, for U_2Rh the upper temperature range is not necessarily the transformation temperature of this compound. (10 figures, 26 references) (auth)

30005 EMPIRICAL APPROACH TO THE LINEWIDTHS OF MIXED SYSTEMS: RAMAN SCATTERING OF CeO_2–ThO_2. Kern, S.; She, C. Y. (Colorado State Univ., Fort Collins). Chem. Phys. Lett.; 25: No. 2, 287-289(15 Mar 1974).

We have successfully applied an entropy of mixing approach to the empirical prediction of the linewidths for Raman scattered radiation from the CeO_2–ThO_2 system. It appears to be applicable to fluorescent linewidths as well as to the Raman linewidths of other systems. (auth)

30006 ELECTRICAL CONDUCTIVITY OF UO_{2+x}. Lee, H. M. (Northwestern Univ., Evanston, IL). J. Nucl. Mater.; 50: No. 1, 25-30(Feb 1974).

Isothermal and isobaric conductivities of UO_{2+x} were measured as a function of oxygen pressure and temperature. Intrinsic disorder predominates at low-oxygen pressures. The pressure dependence of the conductivity can be expressed as $\sigma = P_{O_2}^{\frac{1}{n}}$ in the intermediate oxygen pressure range in which more than one type of charge carrier predominate. At high oxygen pressures, it is proposed that oxygen vacancy-interstitial trios in association with U^{+5} ions facilitate the fast transport of oxygen interstitials in the region. (auth)

30007 ANALYSIS OF Pu SEGREGATION AND CENTRAL-VOID FORMATION IN MIXED-OXIDE FUELS. Meyer, R. O. (Argonne National Lab., IL). J. Nucl. Mater.; 50: No. 1, 11-24 (Feb 1974).

A description of plutonium segregation and central-void growth is given in a model that includes both a vapor-transport and a sintering mechanism. The calculated results presented are in good agreement with observed results; this indicates that the essential features of the phenomena have been included in the model. The importance of the sintering mechanism is emphasized, since this mechanism controls the extent of plutonium segregation and dominates the central-void-growth process. Solid-state diffusion is shown to be relatively unimportant in the segregation process, and several insights into fuel-element performance are

noted from preliminary calculations. (10 figures, 41 references) (auth)

30008 EFFECT OF GRAIN SIZE ON SWELLING AND GAS-RELEASE PROPERTIES OF UO_2 DURING IRRADIATION. Turnbull, J. A. (Centeral Electricity Generating Board, Berkely, Eng.). J. Nucl. Mater.; 50: No. 1, 62-68(Feb 1974).

UO_2 specimens of two different grain sizes were irradiated at 1750°C up to 0.4% FIMA and measurements made of fission-gas release and dimensional changes. Results show a significant reduction of both these effects with increasing grain size. Also, at swelling values around 10%, the major contribution to swelling was due to grain-edge tunnels which were extensively interlinked to the free surface. The consequence of this is discussed regarding models for both gas release and swelling. (5 figures) (auth)

30009 ETCHING OF Al_2O_3 SURFACES WITH MOLTEN V_2O_5. Safdar, M.; Frischat, G. H.; Salge, H. (Technische Univ. Clausthal, Clausthal-Zellerfeld, Ger.). J. Amer. Ceram. Soc.; 57: No. 2, 106-107(Feb 1974).

Micrographs are presented to show the unevenness of Al_2O_3 surfaces etched using molten V_2O_5 as specified in the procedures for a patented process. The micrographs show the position of line profile scans and qualitative scan obtained using an electron microscope. (JRD)

30010 CRYSTALLIZATION OF METASTABLE ALUMINAS IN THE PRESENCE OF V_2O_5. Bye, G. C.; Gavin, D. G. (Univ. of Sheffield, Eng.). J. Amer. Ceram. Soc.; 57: No. 2, 55-57 (Feb 1974).

In investigating possible effects of high temperatures on a V_2O_5/γ-Al_2O_3 catalyst, it was found that metastable aluminas with unusually well-developed crystallinity can be prepared in the presence of V_2O_5. With control of firing temperature, time, and atmosphere, υ-, θ-, and κ-Al_2O_3 could be obtained in this state. X-ray powder diffraction patterns containing many more lines than usually observed were indexed, unit-cell dimensions calculated, and values compared with previous data. All preparations contained small amounts of V which could not be removed by H_2O_2; ESR revealed V^{4+} ions in them. (auth)

30011 CORRELATION OF WORK-OF-FRACTURE AND FRACTURE TOUGHNESS FOR ZrO_2 PARTIALLY STABILIZED BY CaO. Green, D. J.; Nicholson, P. S. (McMaster Univ., Hamilton, Ont.). J. Amer. Ceram. Soc.; 57: No. 2, 105-106 (Feb 1974).

Research directed to derivation of equations for 4-point bending work-of-fracture for ZrO_2 partially stabilized by CaO is described. Values obtained using the derived equations are presented and analyzed. It is noted that it is not clear how well the elastic flexure theory applies to CaO–ZrO_2 systems where there is a nonlinear elastic region as a result of microcrack formation preceding maximum load. (JRD)

30012 VIBRATIONAL SPECTRA OF SPODIOSITE ANALOGS. Kowalczyk, L. N.; Condrate, R. A. Sr. (Alfred Univ., NY). J. Amer. Ceram. Soc.; 57: No. 2, 102-105(Feb 1974).

Spodiosite analogs are a class of compounds related to the apatite family. The ir spectra (4000 to 200 cm^{-1}) and the laser-Raman spectra were obtained for several analogs ($Ca_2(XO_4)Cl$ in which X = P, As, or V) prepared by a reaction flux technique. Fundamental modes were identified, and empirical band assignments were made. Unquestionable band assignment of the ν_2 modes can be made using Raman spectra. Effects of solid-state interactions were noted in the spectra and interpreted by factor-group analysis using the factor group D_{2h}. The spectra of chlorspodiosite ($Ca_2(PO_4)Cl$) were compared with the spectra of synthetically prepared chlorapatite. (auth)

30013 CHARACTERIZATION AND STABILIZATION OF METASTABLE TETRAGONAL ZrO_2. Mitsuhashi, T. (National Inst. for Research in Inorganic Materials, Ibarakiken, Japan); Ichihara, M.; Tatsuke, U. J. Amer. Ceram. Soc.; 57: No. 2, 97-101(Feb 1974).

Fine single-domain and polydomain particles of tetragonal ZrO_2 were prepared by hydrothermal and heat treatment of $ZrO_2 \cdot nH_2O$. The particles were characterized by x-ray diffraction, electron microscopy, NMR, mass spectrometry, and ir spectroscopy. The main impurity in the samples was 1 to 2 wt % OH^- ions, most of which were concentrated on the particle surfaces or at domain boundaries; some were also distributed in the lattice. Fine single-domain tetragonal particles were strain-free, but polydomain particles had large strains. The single-domain tetragonal particles were transformed much more easily than the polydomain particles by mechanical treatment. The stabilization of metastable tetragonal ZrO_2 cannot be explained adequately by the surface-energy theory. An explanation based on the concept of a martensitic transformation may be more reasonable. (auth)

30014 TRANSITION FROM IONIC TO ELECTRONIC CONDUCTION IN PURE ThO_2 UNDER REDUCING CONDITIONS. Choudhury, N. S.; Patterson, J. W. (Iowa State Univ., Ames). Amer. Ceram. Soc.; 57: No. 2, 90-94(Feb 1974).

Open-circuit emf and ac conductivity studies were conducted on two batches of dense polycrystalline ThO_2. The open-circuit emf data were used to delineate the low-P_{O_2} ionic domain boundary for "pure" ThO_2, which is presented as a log $P_\oplus$ line on a log P_{O_2}-$1/T$ diagram. In addition the ionic conductivity, σ_{ion}, and the high-P_{O_2} log $P_\oplus$ boundary were also determined, mainly from ac conductivity measurements, which also confirmed the $P_{O_2}^{\frac{1}{4}}$ dependence of σ_p, the p-type electronic conductivity, shown by other investigators. The main results are, for the first batch, $\log P_\ominus = 12.7 - 220.2 \times 10^3/4.575T$, $\log \sigma_{ion} = 1.9 - 44.3 \times 10^3/4.575T$, and $\log P_\oplus = -1.0 - 31.4 \times 10^3/4.575T$; for the second batch, $\log P_\ominus = 11.2 - 219.7 \times 10^3/4.575T$, $\log \sigma_{ion} = 1.7 - 41.6 \times 10^3/4.575T$, and $\log P_\oplus = 0.6 - 40.4 \times 10^3/4.575T$. The oxygen permeability of ThO_2 tubes and the oxidation rate constant of Th were predicted from the conductivity and emf data and compared with direct measurements previously reported. The calculated and previously measured permeabilities agreed very well; however, the correlation between the predicted and previously measured oxidation kinetics was somewhat less satisfactory. (auth)

30015 ACOUSTIC EMISSION AND SEMICONDUCTOR–METAL TRANSITION IN VO_2 THIN FILMS. McBride, S. L.; Hutchison, T. S.; Murphy, R. (Royal Military Coll. of Canada, Kingston). Scr. Met.; 8: No. 4, 431-434(Apr 1974).

Acoustic emission from a thin VO_2 film was measured on cycling the temperature (59 to 90°C) through the phase transition at ~68°C. The acoustic emissions occur during and after the transition for both increasing and decreasing temperature; thus, the emissions probably arise from lattice changes and not the unit cell change. (DLC)

30016 MARTENSITIC PHASE TRANSFORMATION IN ZIRCONIA (ZrO_2). II. Crystallographic Aspects. Bansal, G. K.; Heuer, A. H. (Case Western Reserve Univ., Cleveland). Acta Met.; 22: No. 4, 409-417(Apr 1974).

Crystallographic aspects of the martensitic tetragonal → monoclinic phase transformation in zirconia single crystals have been studied experimentally and compared with predictions of the phenomenological theory of martensite crystallography. Two different orientation relationships have been observed between the high and low temperature phases. Above 1000°C, the transformation occurs according to the orientation relations $(100)_m \parallel \sim(100)_t$ and $[010]_m \parallel \sim[001]_t$, while below 1000°C, $(100)_m \parallel \sim(100)_t$ and $[001]_m \parallel \sim[001]_t$ were observed. These results indicate that the habit planes of the plate-like martensite products reported in the first paper of this series [Acta Met. 20, 1281 (1972)] had been incorrectly indexed; this occurred because of an incorrect assumption that a single crystal undergoing a monoclinic → tetragonal → monoclinic cycle would return to its original orientation at the end of the cycle. Application of the phenomenological theory of martensite crystallography indicates that the observed habit planes can be predicted using a single Bain correspondence, implied by the lower temperature orientation relations, combined with different lattice invariant deformation modes. (auth)

30017 STUDY OF THE Eu–O SYSTEM: MEASUREMENT OF THE CONDUCTIVITY. Bideau, D.; Grosvald, G.; Padiou, J. (Univ., Rennes, France). Phys. Status Solidi (a); 22: No. 1, 225-229(16 Mar 1974). (In French).

The dc conductivity of europium oxides in the composition range EuO to Eu_2O_3 was measured at 20 to 400°C. Results show that the previously observed dielectric relaxation phenomenon is due to a dipolar mechanism. (auth)

30018 EFFECT OF SURFACE IMPURITIES ON RADIATION-INDUCED CHANGES IN MOS STRUCTURES. Litvinov, R. O.; Litovchenko, V. G.; Radeske, C. (Inst. of Semiconductors, Kiev). Phys. Status Solidi (a); 22: No. 1, 293-298(16 Mar 1974).

The influence of impurities, preliminary BT-treatment, and passivation of MOS-structures Al/SiO_2/Si on radiation-induced changes in charge and density of fast states at the Si/SiO_2 interface was studied. It is shown that the concentration and the distribution across the oxide of an impurity and the defects, associated with it, explain the observed behavior of the charge, induced into the oxide during γ-irradiation under an applied bias. It is found that the density of fast states, induced by radiation, depends on the concentration of defects at the Si/SiO_2 interface, associated with the impurities. (auth)

30019 METHOD FOR PREPARING HOLLOW METAL OXIDE MICROSPHERE. Schmitt, C. R. (to United States Atomic Energy Commission). US Patent 3,792,136. Feb 1974. Filed date 2 Nov 1971. 6p.

Hollow refractory metal oxide microspheres are prepared by impregnating resinous microspheres with a metallic compound, drying the impregnated microspheres, heating the microspheres slowly to carbonize the resin, and igniting the microspheres to remove the carbon and to produce the metal oxide. Zirconium oxide is given as an example. (Official Gazette)

30020 INVESTIGATION OF THE INFLUENCE OF TEST CONDITIONS ON THE ABRASIVE WEAR RESISTANCE OF REFRACTORY COMPOUNDS. Bovkun, G. A.; Medvedeva, O. A. (Inst. of Problems of Material Behavior, Kiev). Ind. Lab. (USSR) (Engl. Transl.); 38: No. 12, 1912-1914(Dec 1972).

Translated from Zavod. Lab.; 38: No. 12, 1515-1518(Dec 1972).

Alundum, silicon carbide, and boron carbide abrasive papers were used in the tests at pressures on the sample of 200 to 500 g. Results show that the method of abrasive wear testing of materials by rubbing against fastened abrasive particles may be used for determining the wear resistance of refractory compounds. It was also found that an abrasive surface, boron carbide paper must be used since only with this will the values of wear resistance characterize the true resistance of refractory compounds to the scratching action of abrasive particles. The abrasive particle size must not exceed 100 μ with the use as a standard of a metal or alloy. The load on the sample must not exceed 420 g (a load for a single abrasive particle of 140 g) since a directly proportional relationship of the wear of the sample to load is maintained only up to this value. (auth)

30021 GROWTH OF MONOCLINIC ZrO_2 SINGLE CRYSTALS BY Na_3AlF_6 FLUX METHOD. Ushio, M.; Sumiyoshi, Y. (Gunma Univ., Kiryu, Japan). Nippon Kagaku Kaishi; 1973: No. 12, 2295-2301(Dec 1973). (In Japanese).

Monoclinic ZrO_2 single crystals were grown from the fluxed melt of 22 wt % ZrO_2 and 78 wt % Na_3AlF_6 by slow cooling under the evaporation of the flux components. A starting mixture was placed in a 100 ml platinum crucible. After maintaining it in the range of temperatures from 1010 to 1080°C, it was cooled at a constant rate from 1 to 10°C/h. ZrO_2 single crystals were found in the growth at a higher temperature and a faster cooling rate. When air-cooled from 1024°C at the rate of about 200°C/h, only small ZrO_2 single crystals were obtained. Many of monoclinic ZrO_2 single crystals grown were of tabular form which was generally bounded by {100}, {110} and {111} faces and their maximum size was $6.7 \times 4.0 \times 1.4$ mm^3. Some of them were twins on parallel growths. Crystals were shown to be very pure by spectroscopic analyses, and also had few cavities. The amount of evaporation from the fluxed melt was about 7.5 g/day (1050°C), depending upon a sectional area of the crucible. Many crystals showed growth hills similar to an acorn, a rhomb, and a circle in shape on {100}, {010} and {111} surfaces, respectively. Etching of ZrO_2 crystals was made with a hot 46% HF etchant. The etch pits resulting from a several hours' etch were slender hexagonal and these from a long hours' etch were rhombic on {100} surfaces. (auth)

30022 RCo_5-H AND RELATED SYSTEMS. Kuijpers, F. A. Delft, Netherlands; Technische Hogeschool (1973). 114p.

Thesis.

Data and information are presented on reactions of H and rare earth metals (R). Sections are included on RCo_5-N, and RNi_5-H systems, pressure-composition isotherms, structure of RCo_5 hydrides, magnetization of RCo_5 compounds, and magnetoisobaric effects in RCo_5H_x. (JRD)

30023 CHARACTERIZATION OF POLYCRYSTALLINE LAYERS BY CHANNELING MEASUREMENTS. Sigurd, D.; Bower, R. W.; van der Weg, W. F.; Mayer, J. W. (California Inst. of Tech., Pasadena). Thin Solid Films; 19: No. 2, 319-328(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

Properties of polycrystalline Pd_2Si layers formed on ⟨111⟩ Si single-crystal substrates have been investigated by channeling measurements. Previous x-ray pole figure analysis indicated that the Pd_2Si layers have a preferential orientation of the c-axis parallel to that of the ⟨111⟩ axis of the substrate. The spread in crystallite orientations was found to depend strongly on heat treatment. The present measurements indicate that channeling minimum yields in these layers depend on this spread in orientation, and they show that channeling techniques can be used to obtain information on the orientation of polycrystalline films when the spread is of the order of the critical angle for channeling (~1°). Minimum yields have been measured for protons and for $^4He^+$ ions incident at energies from 0.2 to 2 MeV. Contrary to what is ordinarily observed for disordered single crystals, it was found that the minimum yields for the polycrystalline layers decrease markedly with decreasing beam energy. Assuming a gaussian distribution of crystallite orientations, calculations of the energy dependence of the minimum yield are consistent with the experimental findings. (auth)

30024 MECHANICAL AND ELASTIC PROPERTIES OF CERMETS IN THE ZrB_2-ZrO_2-W SYSTEM. Avgustinik, A. I.; Ordan'yan, S. S.; Serbezova, R. Ya.; Fishchev, V. N. (Inst. of Tech., Leningrad). Refractories (USSR) (Engl. Transl.); 14: No. 3-4, 188-190(1973).

Translated from Ogneupory; 14: No. 3, 52-55(Mar 1973).

It is shown that with an increase in the content of metal bond (tungsten), the thermal shock resistance and elasticity modulus are increased. The mechanical characteristics completely satisfy the requirements of constructional materials. The properties determined include Young modulus, shear modulus, Poisson ratio, and bend and compressive strengths. (DLC)

30025 HIGHLY REFRACTORY MATERIAL BASED ON ZIRCONIA STABILIZED WITH YTTRIUM AND ALUMINUM OXIDES. Andreeva, A. B.; Leonov, A. I.; Keler, E. K. (Inst. of Silicate Chemistry, Moscow). Refractories (USSR) (Engl. Transl.); 14: No. 3-4, 244-246(1973).

Translated from Ogneupory; 14: No. 4, 42-45(Apr 1973).

With combined additives (Y_2O_3 + Al_2O_3), zirconium dioxide forms solid solutions which resist thermal decomposition. A material was synthesized containing from 90 to 93 mol % ZrO_2, from 3.5 to 5 mol % Y_2O_3, and from 3.5 to 5% mol Al_2O_3, possessing an average coefficient of thermal expansion which is lower, and a thermal-shock resistance which is higher, than the double solid solutions in the systems ZrO_2-Y_2O_3 and ZrO_2-CaO. (auth)

30026 GRANULAR Y_2O_3 CERAMICS OBTAINED BY SINTERING AND HIGH-FREQUENCY FUSION. Balkevich, V. L.; Borovkova, L. B.; Lukin, E. S.; Poluboyarinov, D. N.; Nemchenok, Z. O.; Titova, M. K. (Moscow Chemical Engineering Inst.). Refractories (USSR) (Engl. Transl.); 14: No. 3-4, 247-252(1973).

Translated from Ogneupory; 14: No. 4, 45-50(Apr 1973).

Fused yttrium oxide and apparently other highly refractory oxides and compounds can be used to produce, by the direct high-frequency heating method, highly pure fused materials which together with sintered materials may find application in the production of granular structured refractories. An investigation of the sintering of granular ceramics from fused and sintered Y_2O_3 in relation to the grain size composition, temperature, and time of firing show that the sintering of granular bodies from Y_2O_3 generally obeys the law for the sintering of coarsely grained powders. The basic thermomechanical properties of granular structured ceramics from Y_2O_3 were characterized, and no essential difference in the properties of ceramics based on fused and sintered Y_2O_3 was detected. The resulting refractories of granular structured Y_2O_3 have a sufficient density and strength, a high refractoriness under load of 2 kg/cm^2, low creep rates and volatilization rates, excellent electric insulating properties in vacuum and in air, and can be used as highly refractory construction materials. (5 figures) (auth)

30027 THERMAL CONDUCTIVITY OF FUEL ELEMENTS. I. Uranium Dioxide. Chamero Ferrer, A.; Gispert Benach, M. Energ. Nucl. (Madrid); 17: No. 85, 343-356(1973). (In Spanish).

The difficulties and problems in the determination of the thermal conductivity of UO_2 are analyzed. The most recent publications on the measurement of UO_2 thermal conductivity are summarized. The factors affecting the conductivity-porosity, stoichiometry, and irradiation—are theoretically interpreted. (tr-auth)

30028 INFLUENCE OF COUNTING GASES UPON THERMALLY STIMULATED EXOELECTRON EMISSION OF BeO. Kirihata, H. (Science Univ. of Tokyo); Akutsu, J. Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 67: No. 4, 157-160(Dec 1973).

The influence of counting gases on the thermally stimulated exoelectron emission of BeO excited by x-rays was studied between 25 and 550°C using a gridded gas-multiplication counter. The difference of counting gases in addition to an effective potential difference between the grid and the sample caused a very large change of emission intensity. In order to obtain accurate information on this effect, some discussion on the experimental apparatus is included. (auth)

30029 LATTICE CONSTANTS OF NONSTOICHIOMETRIC ThC AT HIGH TEMPERATURE. Natsume, H.; Matsumoto, M.; Honma, T. (Tohoku Univ., Sendai). Tohoku Daigaku Senko Seiren Kenkyusho Iho; 29: No. 1, 79-88(Jun 1973). (In Japanese).

The lattice constants of nonstoichiometric ThC (C/Th = 1.2, 1.1, 1.0, 0.92, 0.83, 0.79, 0.76, 0.72, 0.66, and 0.54) were measured directly using high temperature x-ray diffractometer from room temperature to 1100°C. It was found that the homogeneity range of ThC phase is C/Th = 0.65 to 0.66 and up to 1.0 at room temperature, whereas the range does not change at temperature up to 1050°C. The thermal expansion coefficients of ThC decrease with the increase of C/Th in the phase of ThC. At C/Th is above 1.0 and below 0.65 to 0.66, the thermal expansion coefficients are constant, respectively. The thermal expansion coefficients of

C/Th = 0.76 vary in the temperature range 700 to 800°C. These values are 7.1×10^{-6}/deg and 8.5×10^{-6}/deg in the low and high temperature range, respectively. (auth)

30030 SOME RADIATION-OPTICAL PHENOMENA IN $LaNbO_4$:Tb^{3+} CRYSTALS. Vakhidov, Sh. A.; Morozov, A. M.; Nurullaev, E. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 62-64(1973). (In Russian).

The behavior of $LaNbO_4-Tb^{3+}$ in a field of nuclear radiation and the effect of the radiation-induced defects on its physical characteristics are studied. The photoluminescence, radioluminescence, and thermoluminescence of this crystal irradiated by γ radiation are determined at 308 and 77°K. The results are shown graphically. (JSR)

30031 INVESTIGATION OF LATERAL DAMAGE EFFECTS OF ION-IMPLANTED LAYERS BY BACKSCATTERING TECHNIQUES. Schmid, K.; Mueller, H.; Ryssel, H.; Ruge, I. (Univ., Munich). Thin Solid Films; 19: No. 2, 313-318(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

Using a particle beam of small diameter the back-scattering technique can be applied to the microanalysis of small geometries. By moving a sample in steps of 5 μm with respect to the beam, lateral properties of the surface layers can be investigated. Particle beams of He^+ ions with diameters of 5 to 100 μm have been used. It was found that the width of a damaged area which was defined by SiO_2 masking during ion implantation was smaller than the width of the window in the mask itself. A wire for masking was placed at a distance of 1 mm from the surface of the sample. In this case lateral annealing of the implanted area was observed, which might be due to an effect of the scanning ion beam. (auth)

30032 RELATIVE PERMITTIVITY OF GAMMA-IRRADIATED BARIUM TITANATE SINGLE CRYSTAL. Kobayashi, S.; Tsunoda, H. (Tokyo Univ. of Agriculture and Tech.). Radioisotopes (Tokyo); 22: No. 11, 650-652(Nov 1973). (In Japanese).

30033 UO_2 FUEL IRRADIATION TESTS BY JOINT RESEARCH PROGRAM OF FIVE FUEL MANUFACTURING COMPANIES. Nakamura, Y. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Nippon Genshiryoku Gakkaishi; 15: No. 12, 822-831(Dec 1973). (In Japanese).

Mitsubishi Atomic Power Industries Inc., Tokyo Shibaura Electric Co. Ltd., Hitachi, Ltd., Sumitomo Electric Industry, Ltd. and Furukawa Electric Co. Ltd., were given a series of subsidy by the government on UO_2 fuel irradiation tests in the fiscal year of 1963, 1964, and 1965. The Power Reactor & Nuclear Fuel Development Corp. (PNC) and Japan Atomic Energy Research Institute (JAERI) collaborated mainly by conducting pre- and post-irradiation examinations. A wide variety of specimens including conventional pellet type fuel, vibratorily compacted fuel and special pellet fuel containing burnable poison materials has been irradiated at various irradiation conditions. Comprehensive results of observation are described. (auth)

30034 PREPARATION OF CERIUM-TUNGSTEN BINARY OXIDES ($2Ce_2O_3 \cdot 9WO_3$, $Ce_2O_3 \cdot 3WO_3$, $Ce_2O_3 \cdot 2WO_3$) FROM CeO_2 AND WO_3. Yoshimura, M.; Sata, T.; Nakamura, T. (Tokyo Inst. of Tech.). Nippon Kagaku Kaishi; 1973: No. 12, 2287-2294 (Dec 1973). (In Japanese).

The reaction products from CeO_2 and WO_3 were studied by quenching method and TG-DTA in air, oxygen and argon (Po_2 = 10^{-5} atm) atmospheres at 650 ~ 1400°C. Two new binary oxides $2\ Ce_2O_3 \cdot 9\ WO_3$ and $Ce_2O_3 \cdot 2\ WO_3$, were found in addition to well-known $Ce_2O_3 \cdot 3\ WO_3$. Their x-ray powder diffraction patterns, chemical and magnetic properties, and melting points and transition points were studied. The mp were 1026 ± 10°C for $2\ Ce_2O_3 \cdot 9\ WO_3$, 1070 ± 10°C for $Ce_2O_3 \cdot 3\ WO_3$, and 1395 ± 10°C for $Ce_2O_3 \cdot 2\ WO_3$. $Ce_2O_3 \cdot 3\ WO_3$ and $Ce_2O_3 \cdot 2\ WO_3$ had the reversible transition point at 1005 ± 10°C and 1105 ± 10°C, respectively. Different products were obtained according to atmospheres and temperatures, even if same reactants were used. That is, $Ce_2O_3 \cdot 2\ WO_3$ was not stable and decomposed to $Ce_2O_3 \cdot 3\ WO_3$ and CeO_2 in air and oxygen, or in argon below 790°C, and $Ce_2O_3 \cdot 3\ WO_3$ was also unstable and decomposed to $2\ Ce_2O_3 \cdot 9\ WO_3$ and CeO_2 in air below 830°C, or in oxygen below 890°C. These results show that the preparation and decomposition of these compounds can be represented by the following equilibrium reactions, $4\ CeO_2 + 9\ WO_3 = 2\ Ce_2O_3 \cdot 9\ WO_3 + O_2$ (1), $4\ CeO_2 + 2(2\ Ce_2O_3 \cdot 9\ WO_3) = 6(Ce_2O_3 \cdot 3\ WO_3) + O_2$ (2), $4\ CeO_2 + 4(Ce_2O_3 \cdot 3\ WO_3) = 6(Ce_2O_3 \cdot 2\ WO_3) + O_2$ (3). The phase relation for these equations in the equilibrium oxygen pressures was determined. The stable region of each compound was shown in Po_2-T diagram. (auth)

30035 EFFECT OF SUPERSONIC TREATMENT OF MIXTURE ON THE PROPERTIES OF HARD ALLOYS. Androsov, V. N.; Letunovskii, V. V. (Krasnoyarsk Polytechnic Inst., USSR). Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 50-53(Feb 1974). (In Russian).

Results are presented of x-ray diffraction analysis of the powder supersonic treatment effect on characteristics of intragranular structures of the hard alloys BK8 and T15K6 (WC and TiC/WC). Supersonic treatment of the powder is established to influence the phase composition and stressed state of the sintered alloys. It is shown that the powder sonic treatment changes the degree of the crystal lattice imperfection and dislocation density. Results are in satisfactory agreement with results of mechanical tests and explain the rise in physicomechanical properties of the alloy produced from the sound-treated mixtures. (auth)

30036 STRUCTURE AND ELECTRICAL CONDUCTIVITY OF THE TERNARY SYSTEM ZrO_2-CeO_2-CoO AT HIGH TEMPERATURES. Dontsov, G. V. pp 92-96 of Teplofizicheskie Svoistva Tverdykh Veshchestv. Samsonov, G. V. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Crystallographic studies of the ternary system ZrO_2-CeO_2-CoO were made with a diffractometer having a copper anticathode. For the phase with a fluorite structure, containing more than 60% CeO_2, the total electrical conductivity was determined by a contact method. The component electron and ion contributions were calculated from the temperature dependence of the total electrical conductivity. The range of existence of the stable fluorite phase was determined. (tr-auth)

30037 NATURE OF VAPORIZATION OF THE TRANSITION METAL CARBIDES. Bolgar, A. S. pp 142-146 of Teplofizicheskie Svoistva Tverdykh Veshchestv. Samsonov, G. V. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Known experimental data on the nature and rate of evaporation and the vapor pressure of the carbides of the transition metals at temperatures up to 3500°K are generalized. It is shown that in going from the carbides of the Group IV metals of the periodic system to those of Groups V and VI there is a redistribution of the fraction of the strength of the metal-metal and metal-carbon chemical bonds in the total bond energy of the carbide, which is due to the nature of the evaporation of these compounds. (tr-auth)

30038 THERMODYNAMIC FUNCTIONS OF NONSTOICHIOMETRIC VANADIUM MONOCARBIDES AT HIGH TEMPERATURES. Turchanin, A. G.; Guseva, E. A.; Morozov, V. V.; Ordan'yan, S. S.; Bolgar, A. S.; Fesenko, V. V. pp 147-151 of Teplofizicheskie Svoistva Tverdykh Veshchestv. Samsonov, G. V. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The enthalpy of vanadium monocarbide of three homogeneous compositions ($VC_{0.88}$, $VC_{0.75}$, $VC_{0.72}$) was determined experimentally at 1300 to 2500°K. The equations of temperature dependence of the enthalphy and the heat capacity of the studied compounds were calculated. The shape of the heat-capacity isotherms of vanadium carbide is discussed on the basis of the generalization of the nature of the chemical bond. (tr-auth)

30039 RARE EARTH MONONITRIDES AND NITRIDES WITH HIGHER NITROGEN CONTENT. I. Kieffer, R.; Ettmayer, P.; Pajakoff, S. (Technische Hochschule, Vienna). Monatsh. Chem.; 103: No. 5, 1285-1298(Sep 1972). (In German).

All rare earth metals (with the exception of Pm) and Y were nitrided with ammonia and nitrogen. Ammonia and nitrogen of normal pressure yield pure and stoichiometric mononitrides. Nitrogen of higher pressure (30 and 300 atm) results in the formation of nitrides with higher nitrogen content. In the case of Ce, Pr, Nd compounds with a REN_2 stoichiometry and an x-ray powder pattern similar to that of the La_2O_3-type can be observed. Higher nitrides of the metals Tb, Dy, Ho, Tm, Lu give powder patterns of the cubic Mn_2O_3-type. (auth)

Metals and Alloys

Refer also to abstracts 28972, 31222, 31600, and 31645.

30040 VYRASHCHIVANIE MONOKRISTALLOV TUGOPLAVKIKH I REDKIKH METALLOV. (Growth of Monocrystals of Refractory and Rare Earth Metals). Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). 144p.

Eighteen papers are presented in the book. A separate abstract was prepared for each paper. (JRD)

For abstracts of individual papers see: 30058-30069, and 30102-30107.

30041 METHODS FOR REVEALING MICROSTRUCTURE OF Zr_3Al-BASE ALLOYS. Ambler, J. F. R.; Schulson, E. M., Kiely, G. P. (Chalk River Nuclear Labs., Ont.). J. Nucl. Mater.; 50: No. 1, 107-110(Feb 1974).

Both attack-polishing and electrochemical polishing were investigated. Although chemical etching can delineate all the phases, anodic color etching and the definitive anodization colors make metallography and photomicrography simple. Electrochemical etching is used to reveal the grain boundaries in the Zr_3Al phase. (DLC)

30042 SINTERED COATING FOR PARTS OPERATING UNDER CONDITIONS OF EROSION WEARING. Ivanov, L. A.; Parkhomenko, G. P. Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 90-94 (Feb 1974). (In Russian).

The wear-resistant sintered coating, in which the hard-alloyed mixture BK6 serves as a filler and solid solution of the Ni–Cr–Si–B system — a fusible bond is considered. The coating is applied to the working surfaces of parts by the dross method with subsequent roasting in vacuum. Test results are presented for the coating of the composition 10 wt.% 1 M + 90 wt.% BK6 against erosion wearing on samples of steel 30 × ГСА. (auth)

30043 PREPARATION OF HIGH-PURITY OXYGEN-FREE Zn TARGET FROM ZnO. Sandor, S.; Katalin, J. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 4, 321-322(1973). (In Hungarian).

Zinc film targets are prepared by vacuum evaporation from the oxide using a tantalum crucible and tungsten heater. The design of the vacuum chamber with electrical connections and mechanical arrangement of components is shown. (SFL)

Corrosion and Erosion

Refer also to abstracts 31219 and 31642.

30044 (AECL-4706) DEVELOPMENT OF OXIDATION-RESISTANT COATINGS FOR ZIRCONIUM ALLOYS. Roy, C. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1974. 30p. Dep. NTIS (U.S. Sales Only) $4.50. AECL $1.00.

Results are given of a new experimental approach to the preparation of protective coatings for zirconium alloys. It consists in forming a diffusion-barrier type coating at the oxide film/environment interface which is remarkably stable at 500 to 600°C. This is achieved by reacting metal coatings such as nickel, copper, etc. with a pre-formed zirconia film on the alloys. The report is divided into three parts: firstly, a brief description is presented of the "state of the art" of preparing metallic coatings that adhere strongly to the preoxidized metal; secondly, the interfacial reactions that lead to the chemical bonding of the metallic coatings to the oxide film are characterized; and thirdly the results are given of the oxidation tests that were performed to assess the protective ability of coatings applied on Zircaloy-2 by the various processes employed. (12 figures) (auth)

30045 (IS-T-618) SURFACE STRUCTURES FROM THE INTERACTION OF AMMONIA WITH TUNGSTEN. Summers, D. L. (Ames Lab., Iowa (USA)). Apr 1974. Contract W-7405-eng-82. 98p. Dep. NTIS $8.00.

Thesis.

LEED was used to investigate surface structures resulting from the interaction of NH_3 and N_2 with W (100) and (111) single crystal faces. At 1000°K and 10^{-6} torr, the steady-state interaction of NH_3 with W(100) results in a (6 × 6) diffraction pattern. The same structure is formed by molecular nitrogen under the same conditions. At lower temperatures the diffraction patterns indicate that a nearly $\frac{1}{7}$ order structure is formed. N_2 or NH_3 interaction with W(111) at 1200°K and 10^{-5} torr result in a (3 × 3) LEED pattern. At ~1000°K, NH_3 forms a $\frac{1}{7}$ order pattern on W(111) which is also observed at pressures as high as 10^{-3} torr. All results were interpreted in terms of reconstructed surface layers of nearly hexagonal geometry. A qualitative explanation was given to correlate the proposed structures with recent kinetic results of NH_3 decomposition on W single-crystal faces. (19 fig, 53 references)

30046 (JPRS-60560, pp 25-42) CORROSION OF MATERIALS IN DINITROGEN TETROXIDE. Sukhotin, A. M. 16 Nov 1973. Translated from pp 29-49 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The corrosion rate of stainless steels in N_2O_4 is investigated as a function of time of contact, flow rates, pressure, and temperature. (SLF)

30047 (JPRS-60560, pp 142-149) KINETICS OF Cr18Ni10Ti STEEL CORROSION IN N_2O_4 AT A HIGH TEMPERATURE AND PRESSURE UNDER CONDITIONS OF REACTOR IRRADIATION. Sukhotin, A. M.; Fedyushin, E. E.; Matushkin, V. A. 16 Nov 1973. Translated from pp 158-165 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The corrosion rate of stainless steel wires was studied under static conditions, using a resistometric method and the IRT-2000 reactor. The irradiation temperature was 550°C, and reactor cycling conditions prevailed. The corrosion rate of Cr18–Ni10–Ti steel in N_2O_4 under irradiation decreases with time, amounting to 0.009 mm/year after 280 h. The same result was obtained in the absence of irradiation. Sheets of the same steel gave lower corrosion rates. (DLC)

30048 (JPRS-60560, pp 150-161) BEHAVIOR OF CONSTRUCTION MATERIALS IN VARIOUS COOLANTS (WATER, STEAM, CARBON DIOXIDE, LIQUID SODIUM, AND N_2O_4). Zorin, N. F.; Kamenev, A. Ya.; Kryukov, V. P. 16 Nov 1973. Translated from pp 166-177 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

A survey is made of the corrosion resistance of stainless steels, Ni-base alloys, and other alloys in N_2O_4 compared to other coolants. Results show that the use of N_2O_4 does not pose corrosion problems different from those encountered in the use of the other coolants; indeed, in some respects N_2O_4 surpasses them. Thus, the impurity content in N_2O_4 can reach 1% without affecting the corrosion resistance of austenitic stainless steel. (6 tables, 27 references) (DLC)

30049 (RD/B/N-2804) USE OF ENERGY DISPERSIVE X-RAY ANALYSIS IN THE STUDY OF LIQUID SODIUM CORROSION AND DEPOSITION PROCESSES. Hooper, A. J.; Fisher, S. B. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1973. 20p. Dep. NTIS (U. S. Sales Only) $4.00.

In order to investigate the corrosion behavior of candidate materials for LMFBRs, the surface compositions of Fe, Ni, and austenitic alloys exposed to flowing Na were analyzed by energy dispersive x-ray analysis used in conjunction with scanning electron microscopy. Results are discussed in terms of corrosion product formation, mass transfer, and particulate deposition. Sodium chromite formed on chromium steels was found to incorporate Al and Si, whilst discrete silicate and alumino-silicate species also appeared to be stable. Mass transfer of the elements Fe, Cr, Ni, and Mn was detected. Particularly high surface concentrations of Fe were found in Ni-rich materials. Particulates containing p-block elements, i.e., Mn, Al, Si, and Ca, were extremely abundant, and particulate deposition of sodium chromite was observed. (UK)

30050 (RD/B/N-2848) INFLUENCE OF STRESS AND STRAIN UPON THE CARBURISATION OF AISI 316 STAINLESS STEEL IN SODIUM AT 450°C. Charnock, W.; Bull, D. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Dec 1973. 25p. (CFR/SMWP/P-(73)91). Dep. NTIS (U. S. Sales Only) $4.25.

Plain and notched specimens of AISI 316 stainless steel were exposed in the pre-stressed and strained condition to sodium of high and low carbon activity at 450°C. Stresses were determined by a strain-gage technique. The depth of carburization as determined metallographically was not affected by stresses and strains in the normal tensile range, nor was carburization enhanced in regions of stress and strain concentration. Unstressed specimens of material cold worked to strains well beyond the normal tensile range (~5) resisted carburization. This resistance may be due to the presence of a high density of precipitate nucleation sites. (UK)

30051 (WAPD-TM-1048) IODINE STRESS CORROSION CRACKING OF ZIRCALOY-4 TUBING (LWBR Development Program). Weinberg, J. G. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Feb. 1974. Contract AT(36-1)-GEN-14. 23p. Dep. NTIS $4.25.

Zircaloy-4 tubing in several conditions of fabrication and heat treatment is subject to a marked reduction in internal pressure rupture strength (40 to 60%) by the presence of iodine vapor at test temperatures of 680 to 800°F. The failures observed have the low ductility characteristics observed in the stress corrosion cracking of other materials. Reaction with ThO_2 reduces the susceptibility to stress corrosion cracking in iodine vapor. (22 fig, 4 tables) (auth)

30052 COEFFICIENTS OF OXYGEN MOLECULES ADHESION ON TUNGSTEN SINGLE CRYSTAL FACES (100) AND (110). Bosov, V. S.; Chuikov, B. A. Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 9, 1571-1572(Sep 1973). (In Russian).

The concentration dependences of the adhesion coefficients for oxygen molecules $S(n_s)$ on the (100) and (110) faces of W single crystals are determined. The measurements are made by the molecular beam method at sample temperatures of 78 to 950°K during the adsorption time T_a. The initial adhesion coefficient on the (100) face is close to unity ($S_o = 0.98$) and does not depend on T_a. On the (110) face it is decreased from 0.3 to 0.1 with increase of T_a. The form of the $S(n_s)$ curve and the equilibrium concentration of the adsorbed molecules changes with T_a for the two faces. The relation $S(n_s)$ for the (100) face has a step-like form varying with T_a. For the (110) face it passes through a maximum. (tr-auth)

30053 CORROSION STUDIES IN AQUEOUS MEDIA EFFECTED BY THE CEA. Coriou, H. (CEN, Fontenay-aux-Roses, France). Develop. Ind. Sci.; No. 16, 30-33(Sep 1973). (In French).

The effects of aqueous corrosion problems on the heat exchangers, fuel element cladding, and force tubes of PWR and BWR type reactors and on irradiated fuel reprocessing plants are discussed. In the nonnuclear field, the CEA is conducting a corrosion test program on the effects of seawater, applications to desalination plants being envisaged. The research carried out by the Corrosion Research and Electrochemistry Service of the CEA at Saclay is also discussed: the corrosion of various materials (strongly or weakly alloyed steels; Ni-based alloys; Al and Mg alloys; copper alloys; U, Zr, Ti, and their alloys) by different media (pure water and aqueous solutions; seawater; steam; gases such as CO_2, CO, O_2, and He; molten salts; liquid metals such as Na). In both the nuclear and nonnuclear domains, the Service makes available to industry the considerable facilities of which it disposes. (FR)

30054 FERRITIC STAINLESS STEELS. Steicherwald, R. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 7-8, 565-568(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 7, 16-20(Jul 1973).

The corrosion resistance of ferritic steels containing N and C and alloyed with Mo was investigated. The corrosion tests were conducted using oxygen-saturated acids and chloride salt solutions. Results are tabulated and discussed. (JRD)

30055 FORMATION OF ZIRCONIUM OXIDE IN MOLYBDENUM ALLOY. Sukhovarov, V. F. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 128-130(1973). (In Russian).

The formation of ZrO_2 in a Mo alloy containing 0.11% Zr, 0.002% B, 0.004% C, and 0.002% O_2 is studied after pre-crystallization annealing at 1200°C for 3 h and high temperature annealing at 1600°C for 1 and 10 h. Dispersed spherical particles of ZrO_2 are observed in the alloy after annealing at 1200°C. The sample annealed at 1600°C for 1 h contained dispersed particles of ZrO_2 in the surface layer. Annealing at 1600°C for 10 h led to the formation of ZrO_2 crystals throughout the entire volume of the alloy. The process of the formation of ZrO_2 at the location of former subboundaries increases with increase of the depth. The pattern of the internal oxidation process is discussed. (JSR)

Preparation and Fabrication

Refer also to abstract 29046.

30056 (LA-UR-74-113) MECHANICAL FABRICATION, HEAT TREATMENT, AND MACHINING OF URANIUM ALLOYS. Boland, J. F.; Sandstrom, D. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 59p. (CONF-740205-10). Dep. NTIS $5.00.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

A review of the state of the art is presented on the fabrication and properties of U-rich alloys in which the alloying elements are highly miscible in γ-U (Nb, Zr, Ti, Mo). Processing of both low alloys (which will not retain a metastable γ phase when quenched) and high alloys (which will retain a metastable γ phase, usually greater than 6% Mo or Nb) is treated. Forging, extrusion, deep drawing, shear spinning, single-point turning, milling, drilling, tapping, and electrical discharge machining are discussed. Heat treatments (metastable, solution treatment, age hardening) to yield the desired mechanical properties are also discussed. (18 figures, 6 tables, 57 references) (DLC)

30057 INTERNAL STRESS IN THIN METAL FILMS PREPARED BY LOW PRESSURE PLASMA SPUTTERING. Shoji, F.; Nagata, S. (Kobe Univ., Japan). Oyo Butsuri; 42: No. 2, 115-123(Feb 1973). (In Japanese).

Internal stress in Ag, Au, Cu, and Mo films prepared by low-pressure plasma sputtering are measured during the deposition by a bending method, and results are compared with evaporated films. At an early stage of film growth where the film is still discontinuous, tensile stress is generated in the sputtered film in the same manner as in the evaporated film. At a later stage when the film becomes continuous, compressive stress is generated in the sputtered film while tensile stress remains in the evaporated film. The origin of the compressive stress is considered to be due to gas incorporation from the investigation of the correspondence between stress and structure in Mo and γ-Mo_2N films prepared by reactive sputtering. (auth)

30058 PREPARATION OF MONOCRYSTALS OF RCo_5 COMPOUNDS BY DIFFERENT METHODS. Savitskii, E. M.; Terekhova, V. F.; Torchinova, R. S.; Mikhailov, B. P.; Davydov, A. A. pp 5-7 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The results of the growing of monocrystals of the compound $SmCo_5$ from melts by the Czochralski pulling method are reported. A study is made of the substructures and magnetic structures of the monocrystals. (tr-auth)

30059 PREPARATION FROM MELTS OF MONOCRYSTALS OF SOME RARE EARTH METALS. Chuprikov, G. E.; Epifanova, K. I. pp 11-13 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The results of the study of the characteristics of the crystalline growth from melts of macromonocrystals of Gd and Tb with a low-temperature structure are reported. The study is made growing of the crystals in a vacuum and in a medium of pure He by the Czochralski method and by the zone-melting method without crucible. These data are compared with earlier results on the growing of Y monocrystals. (tr-auth)

30060 THERMAL CONDITIONS FOR GROWTH OF MONOCRYSTALS OF GADOLINIUM BY THE CZOCHRALSKI METHOD. Russo, V. L.; Chuprikov, G. E.; Epifanova, K. I. pp 13-17 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitski, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The thermal regime for the growth of mono- and polycrystals of Gd by the Czochralski method is studied. The character of the change of the temperature gradients and the crystallization front determines the growth of the mono- or polycrystals. A semi-empirical method for the determination of the temperature field in the crystal is given. (tr-auth)

30061 GROWTH FROM MELTS OF MONOCRYSTALS OF ALLOYS OF THE Y–Gd SYSTEM. Kralina, A. A.; Chuprikov, G. E.; Ketkin, V. N. pp 18-21 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Oriented macrocrystals of the Y–Gd system with Gd concentration from 0.1 to 6 are grown by the zone melting method without crucible. The effect of the alloying component on the perfection and original orientation of the Y monocrystals is studied by x-ray and metallographic methods. It is established that the increase of Gd concentration causes a sharp increase in the crystal fragmentation. (tr-auth)

30062 PREPARATION OF Nb MONOCRYSTALS DURING HYDROGEN REDUCTION OF $NbCl_5$ FROM THE GASEOUS PHASE. Petrusevich, I. V.; Abramov, V. V.; Firsov, V. I.; Voskresenskaya, L. A.; Sukhov, G. V.; Nisel'son, L. A. pp 29-33 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The process of hydrogen reduction of $NbCl_5$ on a heated surface is used for the growth of Nb monocrystals. The $NbCl_5$ is first purified by effective rectification. Nb wire or Nb tape is used as a backing. It is established that at a backing temperature of 1600°C and with the molar ratio of H_2: $NbCl_5$ = 10 Nb monocrystals with a length of 12 mm and a thickness of 2 to 4 mm are grown on individual regions of the heated surface. The growth rate of the monocrystals is 0.6 mm/h. The crystals are formed with well defined faces representing the {110} plane. The growth of monocrystals is observed preferentially in the [111] direction. The determination of metallic impurities in the Nb is done by the neutron activation method. (tr-auth)

30063 PREPARATION OF MONOCRYSTALLINE Mo WIRES BY THE RECRYSTALLIZATION METHOD. Savitskii, E. M.; Burkhanov, G. S.; Ottenberg, E. V.; Nosov, V. P. pp 46-51 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Mo wires with a monocrystalline structure are prepared by the method of recrystallization tempering. The effect of impurities on

the grain growth and formation of the crystalline structure during the preparation of Mo monocrystals by the recrystallization method is examined. It is shown that Mo monocrystals obtained by this method are characterized by very perfect substructure and increased ductility in comparison with monocrystals from the electron arc zone melting method. (tr-auth)

30064 PERFECTION OF V MONOCRYSTALS IN RELATION TO THEIR GROWTH CONDITIONS. Koltygin, V. M.; Kostyukova, E. P.; Pikunov, M. V. pp 52-56 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The perfection of V monocrystals as a function of their growth conditions is studied by x-radiographic methods. A quantitative evaluation of the degree of perfection is made from the coefficient of imperfection of the monocrystals. Studies on wires and cross sections show that the greatest dependence of structure perfection on growth rate is shown in metal from aluminothermic reduction. The rosette substructure appearing in the first moment of crystallization of the seed degenerates in proportion to the growth. Sufficiently perfect crystals can be prepared with a stabilized melting regime. (tr-auth)

30065 EFFECT OF RECRYSTALLIZATION CONDITIONS ON FORMATION OF DUCTILE W MONOCRYSTALS. Kralina, A. A.; Permyakov, A. I.; Puzanova, L. V.; Romanov, E. P.; Smirnov, L. V.; Sokolov, B. K.; Fokina, E. A. pp 56-62 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Samples of cast industrial W with a thickness of 0.5 mm of commercial purity are subjected to a recrystallization tempering in installations with electron arc heating under the melting point. The rate of movement of the zone at which concurrent growth of the crystals is developed is selected. This made it possible to obtain monocrystalline films. It is established that the tendency to concurrent growth and the orientations of the growing crystals is determined by the type of original texture. Metallographic and x-radiographic studies of the degree of perfection of the crystals are made. The results obtained make possible assumptions on the effect of inhomogeneities of the thermal field on this characteristic. (tr-auth)

30066 PREPARATION OF NONPOROUS Mo MONOCRYSTALS OF INCREASED DIAMETER. Mikhailov, S. M.; Chechentsev, V. N.; Shmakov, A. M. pp 65-68 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

By use of metallographic and x-ray methods studies are made of the effect of the conditions of the zone melting process on the origin of porosity. Stabilization of the melting regime, new equipment, the use of pure monocrystalline wires, and the refinement of the technology of melting made it possible to obtain nonporous monocrystals with a given orientation. As a result of the studies made a technology is introduced for the growth of nonporous Mo monocrystals with a diameter up to 35 mm and a length of 250 to 300 mm with impurities of $C \leq 0.006$, $O_2 \leq 0.002$, $H_2 \leq 0.0003$, and $N_2 \leq 0.002$. (tr-auth)

30067 IMPURITY SUBSTRUCTURE OF SURFACE OF CRYSTALLIZATION FRONT OF Mo. Brodskii, I. A.; Petushkov, E. E. pp 79-84 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

A method is developed for the exposure of the surface of the crystallization front of Mo monocrystals in conditions of vertical zone melting in a vacuum with electron heating. The cellular impurity substructure of the surface of the Mo crystallization front is investigated experimentally. The identity of the forms and dimensions of the elements of the cellular substructure of Mo, Sn, and Pb is shown. The effect of the thermoconvection current of the liquid metal of the zone on the dimensions of the subboundaries and the elements of the impurity substructure is examined. At the boundary of the crystallization front the specific elements of the impurity substructure which is called the "boundary substructure" are detected. The presence of columnar growth figures on side surface of the crystallization front and the corresponding impurity substructure of these figures are shown. It is concluded that rapid crystallization of thin layers of fused metals remaining on the surface of the front after its display does not distort the true picture of the crystal growth. (tr-auth)

30068 DISTRIBUTION OF IMPURITIES IN MONOCRYSTALS OF HIGH-PURITY Mo. Kovtun, G. P.; Makarov, V. I. pp 85-86 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

It is established that in Mo monocrystals obtained by electron beam zone recrystallization an irregular distribution of impurities is observed. Displacement to the end of the ingot occurs along the length of the rod. An impurity gradient also occurs in the cross section. Its maximum is on the surface of the sample and the minimum is at the center. (tr-auth)

30069 ANALYSIS OF THE CRYSTALLOGRAPHIC DIRECTION OF W AND Mo MONOCRYSTALS GROWN BY SEEDING. Bolotnikova, K. N.; Garaeva, A. A.; Mikhailov, S. M.; Petushkov, E. E. pp 106-109 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The macro- and microstructure of the seed of W and Mo monocrystals grown under conditions of electron beam zone melting in three basic crystallographic growth lines is studied. It is shown that the most angular characteristics of the mosaic structure are found for monocrystals oriented in the ⟨100⟩ direction. (tr-auth)

30070 ISOLATION OF LOW CONTENTS OF TUNGSTEN USING MANGANESE PEROXIDE HYDRATE (EXCHANGE OF EXPERIENCE). Vinogradov, A. V.; Dronova, M. I.; Lopatina, N. M. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 2, 204-205(Feb 1973).

Translated from Zavod. Lab.; 39: No. 2, 150-151(Feb 1973).

Assessment of the separation process reveals that the precipitates contained ≤0.4 mg U in 250 mg samples and ≤0.15 mg in 50 mg samples. Data on coprecipitation of other transition metals with W using manganese peroxide hydrate are tabulated. (JRD)

30071 CHLORINATION OF ZIRCON SAND. Manieh, A. A.; Spink, D. R. (Waterloo Univ., Ont.). Can. Met. Quart.; 12: No. 3, 331-340(1973).

The reaction between zircon sand and chlorine in the presence of calcined petroleum coke was studied in a static boat reactor and in an electrothermal fluid bed reactor. In the static chlorination studies, the individual effects of temperature, carbon/zircon ratio and per cent chlorine in the chlorinating gas were evaluated. In the fluid bed chlorination studies chlorine utilization was evaluated as a function of temperature, gas velocity and bed depth. The electrothermal fluid bed was found to be ideally suited for this particular chlorination reaction. (auth)

30072 HOT SWAGE FABRICATION OF ZIRCALOY-2 ROD CONTAINING B_4C. Kubota, T.; Takahashi, S. (Mitsubishi Atomic Power Industries, Inc., Saitama, Japan). Trans. Jap. Inst. Metals; 14: No. 6, 504-510(Nov 1973).

High density Zircaloy-2 rods containing B_4C particles (5800 ppM) were fabricated by hot swaging. In the case of the rod swaged with small-sized B_4C (−600 mesh), B_4C particles were found to be continuously distributed along the grain boundary of Zircaloy-2 matrix, while in the case of the rod swaged with large-size B_4C (+200 mesh), B_4C particles were present sporadically. ZrC and ZrB_2 were found to be formed in the rod swaged at 1000°C, while no reaction products were found in the rod swaged at 800°C. The examination of the properties by various testing methods such as corrosion testing, metallography, and hardness change measurement after annealing have indicated the characteristics that depend on the manufacturing condition and the size of dispersed B_4C particles. (auth)

30073 SODIUM TECHNOLOGY. Nippon Genshiryoku Gakkaishi; 15: No. 9, 579-619(Sep 1973). (In Japanese).

The present status of sodium technology for FBR type reactors is reviewed. The thermodynamic properties of Na are shown in a table. Compatibility of molten Na with other materials of the reactor, and especially with SUS 304, 316, and 2.25 Cr−1 Mo steel are stated. Analytical technology concerning latest processes, is reviewed along with other topics and especially measuring methods for radionuclides in primary coolant Na. Fluidity of Na can be treated according to the laws for ordinary fluid flow, but not heat transfer laws. New experimental data of heat transfer of Na have been reserved for information exchange or for the export of technique. Upper limits of impurities have been established empirically, and descriptions are given concerning instruments for measuring impurities using on-line system, purification apparatuses, and cold trap filters. The instruments for FBR type reactors should have resistivity to high temperature Na and a life of about 30 years. Selected specified instruments for Na, are described along with loop equipment, and operation of liquid Na for FBR reactor. Details about Na loops of domestic and foreign countries are presented in tables. (JA)

Properties, Structure, and Phase Studies

Refer also to abstracts 30456, 30991, 31274, 31639, 31641, and 31650.

30074 (AD-768404-6-GA) MICROSTRUCTURE AND PHASE RELATIONS FOR Ti−Mo−Al ALLOYS. Technical Report, 1 October 1970−30 September 1971. Hamajima, T.; Lutjering, G.;

Weissmann, S. (Rutgers–the State Univ., New Brunswick, N. J. (USA). Materials Research Lab.). Nov 1971. Contract F33615-69-C-1322. 22p. NTIS $3.25.

The influence of aluminum additions to a titanium-7 at.% molybdenum alloy on the phase equilibria was investigated. The microstructures of the alloys, Ti–7% Mo–7% Al, and Ti–7% Mo–16% Al, were determined by light and electron microscopy. It was found that with increasing aluminum concentration the formation of the metastable omega phase was suppressed. In the Ti–7% Mo–16% Al alloy the beta phase decomposed upon quenching by precipitating coherent, ordered particles having a CsCl type of crystal structure (beta sub 2). At low temperatures the equilibrium phases for this alloy were beta + alpha + beta sub 2, whereas at high temperature (850°-950°C) the Ti3Al phase was in two-phase equilibrium with the beta phase. The four-phase equilibrium which exists at a temperature of about 550°C involves the reaction beta + Ti3Al reversibly yield alpha + beta sub 2. (GRA)

30075 (BLG-485) DISPERSION-STRENGTHENED FERRITIC STEELS AS FAST REACTOR STRUCTURAL MATERIALS. Huet, J. J.; Leroy, V. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Nov 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Dispersion-strengthened ferritic steels are being studied for possible use as canning material for sodium-cooled fast reactors. A number of properties were examined and up to now, no unfavorable characteristic could be found. The chosen basic alloy contains nominally Fe–13% Cr–1.5% Mo–3.5% Ti to which 2% TiO_2 or 1% Y_2O_3 is added by a powder metallurgy technique. The high-temperature mechanical properties were examined by time rupture tests at 700°C (up to 4000 h); at this temperature, the studied alloys can be really favorably compared with the best austenitic steels. Composition variations occurred in the titanium and silicium contents, but the preparation method allows them to remain easily within the prescribed limits. Cold work may lower strongly the resistance at 700°C; however, a thermal treatment completely restores the properties. Corrosion tests in dynamic sodium at 700°C showed that after 4000 h, the affected zones remained narrow and had no significant influence on the mechanical resistance at high temperature. Neutron irradiations of these alloys, cold and at 700°C, up to respectively 1.6×10^{22}n/cm^2 and 3.10^{21}n/cm^2 (>0,1 MeV), demonstrated their remarkable resistance to embrittlement during mechanical tests at 700°C; comparison with other alloys showed that they had the highest elongation to rupture after irradiation. Simulation tests by high-energy (1 MeV) bombardment gave an almost zero swelling ($\Delta_v/v < 0.5\%$) in a large temperature range. These properties make dispersion-strengthened ferritic alloys excellent candidates as canning material for fast reactor fuel elements. (auth)

30076 (CNLM-2969) EVALUATION OF Cb–5% Zr FUSION WELDS. Stewart, J. R. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 30 Sep 1960. Contract AT(11-1)-229. 10p. Dep. NTIS $4.00.

Declassified 20 Sep 1973.

Bend data show that Cb–5Zr alloy has good ductility in the annealed condition. Some cracking occurred during testing of weld specimens in the following condition: as-welded, welded + annealed at 2200°F in vacuum, and welded + annealed at 2200°F and subsequently placed in a lithium loop at 1800°F for 259 h. The failures occurred either in the weld bead or the heat-affected zone, and at bend angles from 30 to 69°. Corresponding control weld samples of Cb–1Zr alloy subjected to the same pre-test conditioning all bent 180° with no failures. Uniaxial stress-rupture data in lithium for parent and weld specimens of Cb–5Zr alloy are also given. The weld efficiency at 1600, 1800, and 2000°F was above 100%. Failures occurred only in the heat-affected zone of the welds. The weld specimens also showed a much lower secondary creep rate than the parent specimens tested under the same conditions of temperature and stress. The weld specimens at all temperatures showed good ductility when tested in stress-rupture. (auth)

30077 (CONF-7206100-3) EFFECT OF TYPE OF PRODUCT ON THE HIGH TEMPERATURE STRENGTH OF A DISPERSION HARDENED TUNGSTEN ALLOY FOR USE AS FIBER REINFORCEMENT. Wirth, G. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e. V., Porz-Wahn (F.R. Germany). Inst. fuer Werkstoff-Forschung). 1972. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

From 3rd Nordic high temperature symposium; Riso, Denmark (7 Jun 1972).

The creep–rupture and crystallization behavior of two different product types of a W–3% Re–2% ThO_2 alloy which possessed different shape, size, and distance of the ThO_2 particles generated by different working methods during fabrication, is described. (auth)

30078 (COO-3150-20) TESR MEASUREMENTS OF EXCHANGE, CRYSTAL FIELD, AND ENHANCEMENT PARAMETERS IN DILUTE Al : Er ALLOYS. Siebert, J. F.; Dodds, S. A.; Silsbee, R. H. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Feb 1974. 17p. Dep. NTIS $4.00.

Transmission ESR and EPR measurements on unbottlenecked Al : Er dilute alloys are reported. Theoretical expressions are derived for the effects of the exchange and crystal-field interactions on the properties of the resonances. A computer fit of these expressions to the data yields the crystal-field parameters, the sign, magnitude, and a measure of the k-dependence of the exchange interaction, the free ion g value of the Er impurities, and the electron–electron enhancement of the Al host. (auth)

30079 (COO-3460-5) THERMAL COEFFICIENT OF EXPANSION OF AN ACTIVATED VACANCY IN METALS. Final Report. Chhabildas, L. C. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). Jan 1974. Contract AT(30-1)-3460. 8p. Dep. NTIS $4.00.

The initial objective was to measure anisotropic activation volumes and the volume changes associated with creation and motion of defects in the diffusion process. The thermal expansion coefficient of a vacancy was found to be structure-dependent (15 times larger than lattice thermal expansion α_0 for Zn, Cd, bcc Ti, but equal to α_0 for Pb). Other properties of the vacancy are also discussed. (13 references) (DLC)

30080 (EGG-1183-2274) SPALL DATA COMPENDIUM. Charest, J. A. (EG and G, Inc., Goleta, Calif. (USA)). Aug 1972. 73p. Dep. NTIS $5.45.

Fundamental information and experimental data on spall in solid materials are compiled for the Lawrence Livermore Laboratory. Included in the compendium are 1) summaries of the general phenomenological considerations involved in spall measurements, both in the laboratory and in the field, 2) spall models representing both early and recently developed concepts of the dynamic fracture of solids, and 3) elemental data derived from experimental investigations of spall in Al, Be, Ti, and Ta and their alloys, as well as spall in four carbon materials. (auth)

30081 (HEDL-SA-648) EFFECT OF STRAIN RATE AND TEMPERATURE ON THE TENSILE PROPERTIES OF TYPE 308 SMA WELD METAL. Steichen, J. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1973. Contract AT(45-1)-2170. 9p. (CONF-740508-1). Dep. NTIS $3.00.

From annual meeting of the American Welding Society; Houston, Texas, USA (6 May 1974).

A study was made of the effect of deformation rate on the elevated-temperature tensile properties of one material of interest, stainless steel Type 308 shielded metal arc (SMA) weld metal. Testing was performed at strain rates from 3×10^{-5} to 10 s^{-1} and temperatures from 600 to 1200°F on as-welded, thermally aged, and neutron-irradiated material. (auth)

30082 (KFK-1924) PHASE CONVERSION AND PHASE EQUILIBRIUM OF URANIUM–RARE EARTH MIXED OXIDES. Wichmann, U. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). Feb 1974. 81p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis. Submitted to Karlsruhe Univ. (West Germany). Faculty fuer Chemie.

By using a new high-temperature galvanic cell with solid electrolytes, emf measurements on ternary oxides were made at 700 to 1400°C. The determination of the solution-entropy of oxygen in ternary oxides, $\Delta_1 S$, allows to observe temperature-dependent phase transformations, as has been demonstrated for mixed uranium oxides like, e.g., $LaUO_4$, $HoUO_4$, $LuUO_4$, $TmUO_4$, $YbUO_4$, U_4O_9. It was shown that up to 15 mole % uranium in ordered U_4O_9 can be substituted by lanthanum and up to 10 mole % by lutetium without loss of the U_4O_9-superstructure. Mixed oxides with higher amounts of RE(III) crystallize in the disordered fluorite type of structure. By using X-ray diffraction and electrochemical techniques, the phase diagrams of the systems $HoO_{1.5}$–UO_2–O and $LuO_{1.5}$–UO_2–O at 1250°C were established. (26 figures, 8 tables, 55 references) (auth)

30083 (KFK-1925) CREEP-RUPTURE BEHAVIOR OF INCONEL 625 IN THREE DIFFERENT PRETREATMENTS. Schirra, M. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Feb 1974. 50p. (In German). Dep. NTIS (U.S. Sales Only) $5.50.

The creep and time-to-rupture behavior of Inconel 625 was investigated in the temperature range 650 to 800°C. Three different thermomechanical pretreatments were employed: I = hot rolled finish; II = 870°C anneal; III = solution treatment. The temperature range of this study is for samples which have undergone treatment I and II well above the temperatures normally employed. Results show an anomalous stress dependence of creep

and time-to-rupture at around 750°C. The reason is to be found in the very complex precipitation processes occurring while the stress is applied. Results are explained according to newer findings about precipitation in this type of alloy. (28 figures) (auth)

30084 (KHFTI-73-22) ELECTRONIC STRUCTURE AND PROPERTIES OF BERYLLIUM. Papirov, I. I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Teknicheskij Inst.). 1973. 63p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

A review is presented of results of investigations of the electronic structure of beryllium. The influence of the temperature, pressure, and alloying on the Fermi surface were discussed. Metal-chemical, elastic properties, and plasticity of beryllium were analyzed. Peierls force for basic, prismatic, and piramidal slips were determined. On the basis of comparative analysis of the structure, types of bonds, and mechanical properties of beryllium, it was concluded that its fracture was determined by its peculiar electronic structure and anisotropy of bonds in the crystal lattice. (13 tables, 12 figures, 68 references) (auth)

30085 (NRL-7662) J INTEGRAL AND THE INITIATION OF CRACK EXTENSION OF A TITANIUM ALLOY. Yoder, G. R.; Griffis, C. A. (Naval Research Lab., Washington, D. C. (USA)). 24 Sep 1973. 33p.

The J integral was examined as a criterion for the initiation of crack extension in Ti–6Al–4V specimens, for which crack extension occurs long before maximum load. Four types of three-point bend specimens (two thicknesses and two crack lengths) were employed. These fatigue-precracked specimens exhibited loading behavior characteristic of the lower end of the elastic-plastic regime. For each specimen type, values of the J integral were obtained as a function of crack extension, on the basis of a compliance-type calibration which used the plane stress solutions of Bucci et al. Results from all four specimen types suggest that the J-integral value associated with a given amount of crack extension is independent of specimen thickness and initial crack length. For various criteria examined for the initiation of crack extension, the resultant J_{Ic} numbers were in good agreement with ASTM-valid K_{Ic} number obtained for this material. (DLC)

30086 (NRL-7675) EFFECTS OF THE ANISOTROPIC ELASTIC MODULUS OF A BORON-FIBER-REINFORCED ALUMINUM-MATRIX COMPOSITE ON SPECIMENS CALIBRATED FOR CRACK-LENGTH DETERMINATION. Sullivan, A. M.; Stoop, J. (Naval Research Lab., Washington, D. C. (USA)). 17 Oct 1973. 12p.

In an investigation undertaken to assess the suitability of the fracture mechanics parameter K_c for determining the fracture resistance of a boron-fiber-reinforced aluminum-matrix composite, calibration curves designed to measure crack length under load were prepared with specimens at various angles to the fiber axis of the sheet. The effect of the anisotropy of Young's modulus E is reflected in the curves obtained. Scatter in the data indicates that this is not a reliable method for determining crack length for this material, a boron-fiber/6061-aluminum composite. (12 figures) (auth)

30087 (ORNL-tr-2750) BEHAVIOR OF HIGH-TEMPERATURE AUSTENITIC CHROME–NICKEL STEELS WITH BORON UNDER LONG-TERM STRESS. Bungardt, K.; von den Steinen, A. Translated by R. G. Mansfield from Dew Tech. Ber.; 1: No. 4, 138-150(1961). 22p. Dep. NTIS $3.25.

An addition of boron is able to improve the stress-rupture properties of high-temperature metallic materials. Owing to the formation of a boron containing low-melting-point eutectic, a relatively high boron content of approx. 0.08% makes this grade unsuitable for fusion welding. Tests have proved that lower boron contents, i.e., under about 0.015%, do not noticeably reduce the mechanical properties of austenitic steels after fusion welding. Tests are, therefore, carried out with a view to determine in what way such low boron contents which do not greatly impair weldability, may affect the stress-rupture behavior of the austenitic chromium-nickel-(molybdenum) steels, normally used in Germany for long-term stress operations. (SFL)

30088 (ORNL-tr-2808) DEFORMATION AND MICROFRACTURE BEHAVIOR OF TWO-PHASE TUNGSTEN ALLOYS, LIQUID PHASE SINTERED. Votava, E. J. Translated by R. G. Mansfield From Planseeber. Pulvermet.; 21: 79-87(1973). 6p. Dep. NTIS $4.00.

The great ductility of W–Ni–Fe containing 80-94 wt% W and Ni/Fe ratio of 7 : 3, appears to be determined by the following factors: 1. Formation of a ductile matrix and absence of a brittle WNi_4 phase, which inhibits propagation of surface microcracks at the W grain boundaries and self-healing of internal microcracks. 2. Hydrostatic pressure in the interior, which helps to prevent intercrystalline fracture at the W grain boundaries. 3. Formation of highly ductile W single crystal grains, probably due to the very high purity of the material. 4. Good bond between the W grains and the matrix as a result of efficient wetting and prevention of formation of the brittle $WiNi_4$ phase due to the presence of Fe. (auth)

30089 (RD/B/N-2756) DIFFUSION OF MANGANESE IN TYPE 316 AUSTENITIC STAINLESS STEEL. Smith, A. F.; Hales, R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1973. 15p. Dep. NTIS (U. S. Sales Only) $4.00.

The diffusivity of Mn in Type 316 austenitic stainless steel was measured by the standard tracer technique and from the concentration profiles obtained by microprobe analysis after vacuum annealing. Good agreement between diffusion coefficients from both methods, was obtained, confirming the presence of a depleted layer and indicating that effusion of manganese during vacuum annealing is diffusion-rate-controlled. Lattice diffusion of manganese in the temperature range 1023 to 1473°K is given by: $D_L = 0.412^{+0.5}_{-0.3} \exp(-62.1 \pm 0.9)/(RT)$ cm² sec⁻¹. Grain boundary diffusion in the temperature range 923 to 1273°K is given by: $^{g}D_B = (1.6^{+1}_{-0.7}) \times 10^{-6} \exp(-44.7 + 4.2)/(RT)$ cm³ sec⁻¹. (UK)

30090 (TID-26487, pp 213-217) REDUCTION IN FATIGUE PROPERTIES OF 316 STAINLESS STEEL AFTER EXPOSURE TO A SODIUM–WATER FLAME. Marshall, P.; Newman, R. N.; Smith, C. A. (Central Electricity Generating Board, Berkeley, Eng.). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

The effects of controlled diffusion sodium–water flames on the mechanical properties of 316 stainless steel were studied. Results indicate that exposed samples show a considerable reduction in fatigue endurance approximately three orders of magnitude. The samples heated in a butane flame were virtually unaffected. (JGB)

30091 (WASH-1051) RESPONSE TO QUESTIONS OF THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE. Pertaining to the AEC's Advanced High-Temperature Gas Reactor: 710 Program. (General Electric Co., Cincinnati, Ohio (USA)). Nuclear Materials and Propulsion Operation). 24 Sep 1964. 53p. 53p. Dep. NTIS $4.75.

Declassified 28 Nov 1973.

The questions deal with fuel materials experience, comparison of Ta and W, system design specifications, and planned future program. (DLC)

30092 MEASURING THE POTENTIAL OF TWO-COMPONENT INDIUM ALLOYS WITH LEAD, TIN, BISMUTH, OR MERCURY IN A CHLORIDE MELT. Lazarev, N. V.; Pogorelyi, A. D. (North Caucasus Mining-Metallurgical Inst., Ordzhonikidze, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 103-108(1973). (In Russian).

Measurements were carried in a $ZnCl_2$–InCl–NaCl melt at temperatures of 250 to 375°C with a number of indium concentrations. The potentials in the In–Sn system are given by: E (volts) = $0.125 + 0.164 \times 10^{-3}$ T (1.0 wt % In); E = $0.036 + 0.249 \times 10^{-3}$ T (3.0 wt % In), and E = $0.015 + 0.189 \times 10^{-3}$ T (10 wt % In). For the In–Pb system, the relations were: E (volts) = $0.088 + 0.188 \times 10^{-3}$ T (0.1 wt % In); E = $0.060 + 0.162 \times 10^{-3}$ T (1.0 wt % In); and E = $0.026 + 0.643 \times 10^{-4}$ T (10 wt % In). In the In–Bi system, the potentials were: E (volts) = $0.159 + 0.388 \times 10^{-3}$ T (0.1 wt %); E = $0.003 + 0.460 \times 10^{-3}$ T (1.0 wt % In); and E = $0.021 + 0.213 \times 10^{-3}$ T (10 wt % In). In the In–Hg system the potentials were: E (volts) = $0.263 + 0.290 \times 10^{-3}$ T (0.1 wt % In); E = $0.110 + 0.292 \times 10^{-3}$ T (0.1 wt % In); E = $0.110 + 0.292 \times 10^{-3}$ T (1.0 wt % In), and E = $0.091 + 0.089 \times 10^{-3}$ T (10 wt % In). The activity coefficients of indium in these systems were calculated. Positive deviations from Raoult's law were detected in the In–Pb system. The activity coefficients were close to theoretical in the In–Sn system. Negative activity deviations were noted in the In–Hg and In–Bi systems. (SJR)

30093 EFFECT OF TRACE ELEMENTS ON THE STRUCTURE AND PROPERTIES OF Cr–La ALLOYS IN THE CAST STATE. Rakitskii, A. N.; Sarzhán, G. F.; Trefilov, V. I.; Firstov, S. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 45, 12-21(1973). (In Russian).

The effect of nitrogen, carbon, oxygen (0.001–0.1%), and silicon (0.01–1%) on the structure and mechanical properties of Cr and its alloys with 1% La was studied. It was shown that the addition of these trace elements to Cr causes changes in structure of the cast metal (a second phase appears, and the dislocation density increases). It was established that the increase in the dislocation density in Cr contaminated with nitrogen is related to precipitation of needle-shaped chromium nitrides. (tr-auth)

30094 OPTICAL PROPERTIES AND ELECTRONIC CHARACTERISTICS OF CAST SUPERCONDUCTING V–Ga ALLOYS. Golovashkin, A. I.; Levchenko, I. S.; Leskova, T. A.; Vorob'eva, N. S.; Sokolov, V. M. (Lebedev Inst. of Physics, Moscow). Fiz. Metal. Metalloved.; 36: No. 6, 1187-1196(Dec 1973). (In Russian).

The optical constants of cast V–Ga (27.5 to 35 wt % Ga) were measured in the infrared region and for the 27.5 wt % Ga samples, in the visible region. The basic electron characteristics were determined, and it was shown that the properties of the cost alloys were very close to those of alloys made by vacuum vaporization. (tr-auth)

30095 OPTICAL PROPERTIES AND ELECTRON STRUCTURE OF RHENIUM. Nomerovannaya, L. V.; Kirillova, M. M.; Noskov, M. M.; Bolotin, G. A. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 36: No. 6, 1197-1204(Dec 1973). (In Russian).

The optical characteristics of electropolished polycrystal rhenium were measured in the infrared, visible, and ultraviolet region at 295°K (16–0.3 μm) and 77°K (12–0.3 μm). A low-energy quantum absorption band was found in the 0.12 to 1.0 eV region, which was identified with transfers of electrons between states split by spin–orbital interaction. The position of the basic absorption band (1 to 7 eV) corresponds to the region of high density of the state in the rhenium zone spectrum due to d bands. In the field of action of inner-zone accelerating mechanism, the frequency, Ω, and the relaxation frequency, γ, of the conductivity, entering into the dielectric penetrability, were determined to be 7.9×10^{15} sec^{-1} and 1.1×10^{14} sec^{-1}, respectively, at 295°K. (tr-auth)

30096 STRUCTURE OF ALLOYS OF TYPE Nb–Ti–Zr: DIFFUSION SCATTERING OF ELECTRONS AND X RAYS IN ALLOYS CONTAINING 50% Nb. Lyasotskii, I. V.; Tyapkin, Yu. D. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 6, 1260-1270(Dec 1973). (In Russian).

Electron-microscope (micro-diffraction) and x-ray studies of the principles of measurement of diffusion dispersion were made for a number of alloys in the Nb–Ti–Zr (50 at. % Nb) system as a function of composition, thermal processing, and temperature of observation. For all alloys this dispersion is described by concepts of fluctuation wave displacements. (tr-auth)

30097 MECHANICAL-PROPERTY ANISOTROPY IN DEFORMED MOLYBDENUM. Kanevskaya, Ts. A.; Mil'man, Yu. V.; Rachek, A. P.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 36: No. 6, 1278-1284(Dec 1973). (In Russian).

It was shown that anisotropy of the mechanical properties of Mo deformed by rolling is due to the effect of the crystallographic texture, which causes a change in the mechanical properties in accordance with the orientation dependence of these properties in monocrystals and the tendency to lamination. (tr-auth)

30098 MAGNETIC PROPERTIES AND CRYSTAL STRUCTURE OF POWDERS OF TYPE (Sm,Pr)Co_5 ALLOYS. Magat, L. M.; Korotkova, M. N.; Shcherbakova, E. V.; Ermolenko, A. S. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 36: No. 6, 1308-1310(Dec 1973). (In Russian).

Coefficients of strength, width of lines on powder diffractograms, and indexes of reflection for different-size particles are tabulated. The data are inconclusive and the authors conclude that further study is needed. (auth)

30099 TWINNING OF Mg–Cd ALLOY. Igonin, G. S.; Makogon, M. B.; Igonina, T. N. (Siberian Physical-Technical Inst., Novosibirsk, USSR). Fiz. Metal. Metalloved.; 36: No. 6, 1313-1315(Dec 1973). (In Russian).

Ordering in Mg–Cd alloys greatly decreased the number of active twinning systems. The boundaries of disoriented fields are an obstacle to passage of twinning dislocations. (tr-auth)

30100 FIELD ION MICROSCOPY OF URANIUM. I. Preliminary Results. Suvorov, A. L.; Kukavadze, G. M.; Razinkova, T. L.; Sharov, B. V.; Fedorchenko, V. A.; Bobkov, A. F.; Kuznetsov, B. Ya. At. Energ. (USSR); 36: No. 1, 14-18(Jan 1974). (In Russian).

Aspects of obtaining field ion images of uranium specimens are considered. The stability of uranium tips with respect to mechanical tension in the field ion microscope has been investigated. The best results were obtained when using pure argon and the mixture He + 0.5% H_2 as image gases. Aided by a computer, a model of the field ion image of α-uranium and standard stereographic projections for α-uranium on the (010), (001) and (110) planes was constructed. This made it possible to index the crystallographic faces on the obtained micrographs. The adduced preliminary results demonstrate that field ion microscopic analysis (in atomic detail) of uranium specimens is possible in principle. (tr-auth)

30101 X-RAY STUDY OF STACKING FAULTS IN MOLYBDENUM AND MOLYBDENUM ALLOYS WITH RHENIUM. Skorokhod, V. V.; Solonin, Yu. M. (Inst. of Problems in Materials Science, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 1, 88-90(Jan 1974). (In Ukrainian).

Total probability of deformation and twin stacking faults $1.5\alpha + \beta$ was determined in fillings of molybdenum and the following alloys of molybdenum with rhenium: Mo–10 wt % Re, Mo–20 wt % Re, Mo–30 wt % Re, Mo–40 wt % Re and Mo–50 wt % Re. Asymmetry of line (112) was also studied in filings of molybdenum and the alloys Mo–40 wt % Re and Mo–50 wt % Re. A conclusion is drawn that anisotropy of the coherent scattering regions in molybdenum alloys with rhenium is associated with twin stacking faults. (auth)

30102 DISTRIBUTION OF CARBIDES IN CAST TUNGSTEN. Savitskii, E. M.; Povarova, K. B.; Nakonechnikov, A. I.; Bulgak, L. V.; Makarov, P. V.; Kondakhchan, I. G. pp 96-100 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The structure of cast W as well as its nature is determined by the presence of implanted and replacement impurities and by the cooling rate during crystallization. The implantation of carbide-forming metals of Nb and Ta reduces the solubility of C. The introduction of non-carbide forming Re increases the solubility of C in W. The form and distribution of the carbides in W depend on the alloying element and changes from coarse inclusions in unalloyed W to needle-shaped dispersed carbides in alloys of W with Nb and Ta and fine round inclusions in alloys of W with Re. The C affects the ductility of the metal. (tr-auth)

30103 FRACTOGRAPH OF CAST TUNGSTEN. Povarova, K. B.; Savitskii, E. M. pp 100-105 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The structure of cast W is determined by the presence of implanted and replacement impurities and by the rate of cooling during crystallization. The implanted impurities, the primary one being C, comprise the non-metallic inclusions of the carbide, oxide, and compound type. The morphology and distribution of these inclusions depend on the cooling rate of the metal during crystallization. The non-metallic impurities and particularly the carbides are located along the grain boundaries initiating nucleation of fissures at the boundaries. Alloying and reduction of the cooling rate during crystallization affects the fine structure of the W promoting the formation of very sharp polygonal structures, i.e., an increase of dislocation densities and particularly the fraction of screw dislocations. This increases the work expended on the propagation of the fissures during shearing, increased resistance of the material to fracture by shearing. (tr-auth)

30104 EFFECT OF ORIENTATION ON CHARACTER OF SUBSTRUCTURE OF Mo MONOCRYSTALS. Kralina, A. A.; Esin, V. O.; Zholtikova, T. V. pp 110-116 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The results of the x-radiographic investigation of the orientation and substructure of zone melted crystals of Mo grown under similar crystallization conditions are reported. The substructures can be separated into three types according to the character of the distribution of the subgrains: line structure, discontinuous boundaries, and twisting subboundaries. The dependence of the variation of the character of the substructure on the orientation of the growth axis is shown. The formation of any substructure proceeds in a given orientation region in a standard stereographic triangle. Monocrystals whose growth axis is oriented in the direction of preferential growth ⟨100⟩ have the perfect substructure of the line type. The results obtained are discussed from the viewpoint of the effect of the degree of supercooling of the growing surface in the formation of the monocrystal substructure. (tr-auth)

30105 INCLUSIONS IN VANADIUM MONOCRYSTALS. Koltygin, V. M.; Pikunov, M. V.; Lyuttsau, V. G. pp 116-121 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Inclusions are detected in monocrystals of V. It is established that the inclusions are small V crystalline particles, originating through the primary crystallization front and ingrown in the matrix. Their orientation is random and differs from the orientation of the matrix. The distribution longitudinally and along the radius

of the crystal is described. The inclusions are investigated by metallographic and x-radiographic methods and by scanning electron microscopy. (tr-auth)

30106 RAPID METHOD FOR DETERMINATION OF MOSAIC STRUCTURE OF SEEDS USED FOR GROWTH OF W AND Mo MONOCRYSTALS. Bolotnikova, K. N.; Mikhailov, S. M.; Petushkov, E. E. pp 128-131 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

W and Mo monocrystals grown from seeds by the electron beam melting method are studied for the purpose of determining the deviation of the crystallographic lines of the crystals from the seeds. As a result of the study differential distribution functions are constructed for each of the basic directions. These functions characterize the mean angle of deviation. This angle is different for different samples and is characterized by the growth direction. It is established experimentally that the smallest deviation, close to zero, is observed for the (100) plane. The greatest deviation of 3 to 5° is found for the (110) plane. These deviations are explained by the formation of defects of the substructure along the sample and the appearance of elastic stresses during the growth of the monocrystals. (tr-auth)

30107 DETERMINATION OF OXYGEN IN TUNGSTEN MONOCRYSTALS. Mikhailov, S. M.; Navalikhin, L. V.; Petushkov, E. E.; Talanin, Yu. N.; Tserfas, A. A. pp 131-135 of Vyrashchivanie Monokristallov Tugoplavkikh i Redkikh Metallov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

By means of fast neutron activation analysis the oxygen content in W monocrystals obtained by electron beam melting is determined. A regular distribution of the oxygen along the monocrystal is observed. The process for the elimination of the oxygen occurs in two steps, the first of which is characterized by intense separation of the primary part of the impurity. In the second step the reduction of the oxygen content with time proceeds slowly by an exponential law. (tr-auth)

30108 LATTICE DYNAMICS OF SOME SOLIDS WITH hcp STRUCTURE. Upadhyaya, J. C.; Verma, M. P. (Agra Coll., India). Indian J. Pure Appl. Phys.; 11: No. 7, 458-460(Jul 1973).

Phonon dispersion in some hcp metals has been studied on the basis of a modified Sharma-Joshi model [Sharan, B. & Bajpai, R. P., Physics Lett., 31A (1970), 120] with central interaction extended to seventh neighbor. The results show varying degrees of deviation from experimental data corresponding to the $[01\bar{1}0]$ symmetry direction but the agreement in the [0001] direction is found to be invariably good. (auth)

30109 PHONON DISPERSION IN SOME SIMPLE HEXAGONAL METALS. Upadhyaya, J. C.; Verma, M. P. (Agra Coll., India). Indian J. Pure Appl. Phys.; 11: No. 7, 449-457(Jul 1973).

Dispersion curves of three hexagonal metals have been computed on the basis of a modified Sharma-Joshi model [Sharan, B. & Bajpai, R. P., Physics Lett., 31A (1970), 120; J. Phys. Soc. Japan, 28 (1970), 338] with central interactions extended to seventh neighbors. The calculated curves present a reasonably good agreement in the [0001] direction, while there are relatively large deviations from experimental curves in the $[01\bar{1}0]$ direction particularly near the zone boundary. The overall agreement, however, can be considered to be good for a simple eight-parameter theory of the hcp system. (auth)

30110 EFFECT OF GRAIN-BOUNDARY PENETRATION OF AISI TYPE-316 STAINLESS STEEL BY CESIUM OXIDES ON THE BIAXIAL STRESS-TO-FAILURE PROPERTIES. Rosa, F.; Maiya, P. S. (Argonne National Lab., IL). J. Nucl. Mater.; 50: No. 1, 111-115(Feb 1974).

The biaxial stress-to-failure behavior of 20% cold-worked Type 316 stainless steel was studied at 704°C after intergranular penetration by cesium oxides ($Cs_2O + Cs_2O_2$) at 660°C. Time to failure and ductility decrease with intergranular penetration depth; the changes can be explained if the penetration is equivalent to a reduction in the tube-wall thickness. Failure by the pinhole mode at low strain rates is followed by rupture at an average diametral strain rate of 5×10^{-4}/h. (auth)

30111 PREFERRED ORIENTATION IN EXTRUDED MAGNESIUM COMPACTS. Kuzelka, J.; Saxl, I. (Nuclear Research Inst., Rez, Czech.). J. Nucl. Mater.; 50: No. 1, 98-102(Feb 1974).

The preferred orientation in extruded sintered compacts Mg–2% Be, Mg–0.5% MgF_2, and Mg–0.1, 0.3, and 5% MgO was investigated. After extrusion, there is a very sharp fiber texture with the fiber axis (parallel with the extrusion direction) along the $\langle 10\bar{1}0 \rangle$ direction. After secondary recrystallization, the fiber axis is oriented along the $\langle 11\bar{2}0 \rangle$ direction. The time dependence of the recrystallization process is considerably influenced by the dispersed phase content and morphology. Finally, the plastic deformation of the textured compacts is discussed briefly. (auth)

30112 EFFECT OF RESIDUAL STRESSES ON HYDRIDE ORIENTATION IN A Zr–2.5% Nb ALLOY. Hardie, D.; Shanahan, M. W. (Univ. of Newcastle Upon Tyne, Eng.). J. Nucl. Mater.; 50: No. 1, 40-46(Feb 1974).

The distribution of residual stress in quadrants of Zr–2.5% Nb tube after flattening was determined by measurement of the change in curvature during chemical thinning. The "zoning" of hydride precipitate that occurs in such material is then explained in terms of the residual stresses and the elimination of such "zoning" by a prior stress-relief anneal or plastic straining is examined. (8 figures) (auth)

30113 TENSILE DEFORMATION BEHAVIOR OF FINE-GRAINED α-PLUTONIUM. Merz, M. D. (Battelle Pacific Northwest Labs., Richland,WA). J. Nucl. Mater.; 50: No. 1, 31-39(Feb 1974).

Tensile deformation of extruded monoclinic α-plutonium with an average grain size of 4 μm was studied at stress from 2,500 to 100,000 psi (17.3 to 689 MN/m^2) and temperatures from 22 to 108°C. The strain rate varied from 10^{-9} to 7×10^{-3} sec^{-1}. The relation, $\dot{\epsilon} = 2.86 \times 10^{-7}\, \sigma^{4.2} \exp(-25{,}600/RT)$ sec^{-1}, was obeyed from 12,000 to 60,000 psi (71.7 to 414 MN/m^2) for strain rates greater than about 10^{-6} sec^{-1}. Stress and temperature dependences of creep rate over this stress range were in accord with a dislocation climb-controlled creep model, although the power law behavior occurred at stresses higher than theory predicts. The value of 25,600 cal/mole proved a reasonable value for the activation energy for self-diffusion in α-plutonium. At lower stresses, the apparent activation energy for creep increased with decreasing stress, and the stress exponent $n(= d \log \dot{\epsilon}/d \log \sigma)$ increased from 4.2 to 7.9. The high apparent activation energies for creep and high n values at low stresses were attributed to grain growth during creep. Tensile elongation increased with decreasing strain rate and increasing temperature over the entire stress range. Low elongation at high stresses was attributed to lack of grain boundary sliding. Grain size changed during creep toward a size determined by stress. At the highest test temperatures and lowest stresses grain growth occurred during large strains, while at high stresses the average grain size decreased. (8 figures) (auth)

30114 LIMITS ON THE GIBBS FREE ENERGY OF FORMATION OF INTERMETALLIC COMPOUNDS CONTAINING Pt-GROUP ELEMENTS. Wengert, P. R.; Spanoudis, L. (Owens-Illinois, Inc., Toledo). J. Amer. Ceram. Soc.; 57: No. 2, 94-96(Feb 1974).

Upper limits on the standard-state Gibbs free energy of formation (ΔF_f^0) are presented for intermetallic compounds A_nB_m. The A elements include Li, Be, Mg, Ca, Sr, Ba, Al, Si, Y, Sc, La, Tl, V, Nb, Ta, Cr, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu, and the B elements include Pt, Pd, Ir, Rh, Ni, Co, Ru, and Fe. Many of the A elements are used as glass constituents and many of the B elements as container materials for glass at high temperatures. Experiments performed by Bronger and co-workers are the data sources. (auth)

30115 THERMAL ORDERED DOMAINS AND MECHANICAL ANTIPHASE BOUNDARIES AS STUDIED BY ELECTRON MICROSCOPY IN Fe–Co–V. Dinhut, J. F.; Garem, H.; Eymery, J. P.; Moine, P. (CNRS, Poitiers, France). Scr. Met.; 8: No. 4, 307-312(Apr 1974).

An electron microscopic investigation was made of the growth of ordered domains and the creation of antiphase boundary trails by slip of unit dislocations in Fe–49% Co–2% V. The anneal behavior of the antiphase boundaries was also investigated. (DLC)

30116 INFLUENCE OF PRECIPITATION IN AUSTENITE ON MORPHOLOGY OF MARTENSITE IN Fe–Ni–Co–Ta Alloys. Laverroux, M.; Pineau, A. (Ecole des Mines, Corbeil-Essones, France). Scr. Met.; 8: No. 4, 351-356(Apr 1974).

Results are given for precipitation hardening of Fe–23 Ni–8 Ta (aged at 645°C) and Fe–18 Ni–8 Co–8 Ta (aged at 600°C). After aging >10 hr, the martensite transforms from lath to plate (lenticular). The precipitation reaction is austenite. (DLC)

30117 A CRITIQUE: LOGNORMAL ANALYSIS OF THE SNOEK RELAXATION IN Nb–O AND Fe–N ALLOYS. Tewari, S. N. (Purdue Univ., Lafayette, IN). Scr. Met.; 8: No. 4, 371-375(Apr 1974).

It is shown that the relaxation spectrum of interstitial Nb–1.10 at. % O and Fe–0.094 at. % N alloys can be analyzed and explained in terms of a lognormal distribution. Results show that a good fit to the anelastic relaxation data can be obtained by a lognormal distribution analysis as well as a multiple decay

analysis. A procedure is given for determining whether the relaxation spectrum is continuous or discrete. (6 fig) (DLC)

30118 DEPENDENCE OF PINNING-POINT DISLOCATION INTERACTION ENERGY ON DISLOCATION STRUCTURE IN Zr–O ALLOYS. Atrens, A. (Univ. of Melbourne, Parkville, Australia). Scr. Met.; 8: No. 4, 401-412(Apr 1974).

The hypothesis that the yield point is due to dislocations being very firmly pinned in the dislocation cell structure was tested by determining the pinning point dislocation binding energy. Damping measurements were made for Zr containing 0.2 and 1.0 at. % O at 70 to 430°C; they give a binding energy of 0.14 ± 0.03 eV, in good agreement with the theoretical value (0.10 eV) calculated on the assumption that the pinning point relieved the stress field of an edge dislocation. The binding energy (0.5 eV) for dislocations in the cell structure indicates that they are strongly pinned. (15 fig) (DLC)

30119 SURFACE SEGREGATION OF OXYGEN IN Nb–O AND Ta–O ALLOYS. Joshi, A.; Strongin, M. (Brookhaven National Lab., Upton, NY). Scr. Met.; No. 4, 413-424(Apr 1974).

The near-surface distribution of O was studied in Nb–0.1 to 2.3 at. % O and Ta–0.1 to 2 at. % O alloys, using Auger electron spectroscopy and ion sputtering. Results show that large amounts of O segregate to Nb and Ta surfaces, particularly in the 5–15 Å region. O redistributes reversibly between bulk and surface; equilibrium is established almost instantaneously >825°C. Desorption of O becomes appreciable beyond 1200°C. In the intermediate temperature range, ΔH for O segregation varied from 17 to 11 kcal/g atom in Nb and 19 to 6.6 kcal/g atom in Ta as the bulk O content varied from 0.1 to 2 at. %. (DLC)

30120 TRACER DIFFUSION IN α-Zr. Hood, G. M.; Schultz, R. J. (Chalk River Nuclear Labs., Ont.). Acta Met.; 22: No. 4, 459-464(Apr 1974).

Diffusion coefficients of ^{26}Al, ^{44}Ti, ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{60}Co, ^{97}Zr and ^{122}Sb have been measured in α-Zr single crystals at temperatures close to 840°C. The diffusion coefficients of Al, Ti, Zr, and Sb, which are in the range 10^{-14}–10^{-12} cm^2/s, appear to correspond with normal substitutional diffusion behavior. The diffusion coefficients of Cr and Mn are slightly greater than 10^{-9} cm^2/sec, while a value near 10^{-6} cm^2/sec was found for Co. It is considered that the high diffusion coefficients of these solutes reflect the dominance of an interstitial transport mechanism. The results of the present and previous studies of tracer diffusion in α-Zr single crystals show that there is an overall tendency for the solute diffusion coefficient to increase as the atomic radius and the valence of the solute decreases. (auth)

30121 COMPUTER SIMULATION OF THE ELASTIC BULK EFFECT IN TUNGSTEN. Stabell, D. E.; Townsend, J. R. (Univ. of Pittsburgh). Acta Met.; 22: No. 4, 473-479(Apr 1974).

A spherical tungsten crystallite was simulated mathematically to determine the effect of interstitials and vacancies upon the elastic bulk modulus. The crystallite consisted of a lattice region of 330 to 940 atoms which interacted via a two-body central potential. This region was then surrounded by an elastic continuum of various thickness. By introducing point defects into the lattice and applying various pressures to the outer surface of the crystallite, the change in the elastic bulk modulus, K, for vacancies and interstitials was determined. For isolated vacancies $d \ln K/d\gamma = -2.5 \pm 0.1$, and for single interstitials in the ⟨110⟩ split configuration $d \ln K/d\gamma = +1.4 \pm 0.1$ where γ is the atomic fraction defect concentration. Unless the shear modulus is much more sensitive to point defects, these results leave unexplained the large negative changes observed in Young's modulus during irradiation of tungsten at low temperatures. (auth)

30122 DISLOCATION CELL STRUCTURE RELATION $d = K\rho^{-\frac{1}{2}}$: STACKING-FAULT ENERGY DEPENDENCE OF K. Witcomb, M. J. (Univ. of the Witwatersrand, Johannesburg). Phys. Status Solidi (a); 22: No. 1, 299-304(16 Mar 1974).

The Holt relation $d = K\rho^{-\frac{1}{2}}$ between dislocation cell diameter d and average dislocation density ρ is found to apply to Mo–50wt% Re when K = 4. Comparison with other published dislocation cell data shows that K does not remain constant, but varies from metal to metal. The effect of stacking fault energy on the K value is demonstrated to be significant. (31 references) (auth)

30123 EFFECT OF HELIUM ON THE FATIGUE BEHAVIOR OF THE MOLYBDENUM-BASE ALLOY TZM AT 900°C. Michel, D. J.; Serpan, C. S. Jr.; Smith, H. H.; Pieper, A. G. (Naval Research Lab., Washington, DC). Nucl. Technol.; 22: No. 1, 79-87 (Apr 1974).

Results show that the cyclotron-helium-implanted TZM alloy fatigue specimens exhibit almost double the fatigue life of the unimplanted fatigue specimens. Microscopic examination of specimen sections adjacent to the fracture revealed no significant differences between the helium-implanted and unimplanted specimens. However, transmission electron microscope examination of helium-implanted fatigue specimen sections annealed at 1310°C (0.55 T_m), following testing, revealed the presence of cavities within the grain matrix as well as cavities associated with dislocations. By comparison, the unimplanted specimens exhibited a structure characteristic of a well-annealed material. It is concluded that the enhanced fatigue life of helium-implanted TZM alloy at 900°C resulted from the presence of substitutional helium-defect clusters, possibly associated with dislocations and/or precipitates. (8 figures) (auth)

30124 NEUTRON DIFFRACTION STUDY OF SPUTTERED AND ANNEALED Tb–Fe ALLOYS. Pickart, S.; Rhyne, J.; Alperin, H.; Savage, H. (Naval Ordnance Lab., Silver Spring, MD). Phys. Lett.; 47A: No. 1, 73-74(25 Feb 1974).

Sputtered alloys of composition $Tb_x Fe_{1-x}$, with x = 0.118, 0.45 and 0.75 were shown by neutron diffraction to be amorphous. Linewidth measurements of an annealed sputtered sample with x = 0.333 indicate microcrystallinity with a particle size of ≈100 Å. (auth)

30125 STRUKTURA SPLAVOV TSIRKONIYA. (Structure of Zirconium Alloys). Ivanov, O. S.; Adamova, A. S.; Tararaeva, E. M.; Tregubov, I. A. Moscow; Izdatel'stvo Nauka (1973). 199p.

Studies on the structure of Zr alloys published before 1970 are critically generalized. The structure of Zr alloys in the equilibrium and non-equilibrium state are examined. The structure in the equilibrium state is analyzed from the phase diagrams of binary and ternary systems. The general laws for the formation of metastable phases in Zr alloys and the structure of alloys in the non-equilibrium state are shown in specific diagrams of binary and ternary systems. A list is given of the systems examined. (tr-auth)

30126 MOLYBDENUM IN HEAT RESISTANT NICKEL-BASE ALLOYS. Semchishen, M. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 7-8, 569-571(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 7, 20-22(Jul 1973).

The effects of Mo additions on properties of Ni-base alloys containing various amounts of Al and Ti were investigated. It was found that the addition of molybdenum to heat resistant nickel-base alloys substantially increases the solution temperature of γ′ phase and the amount of it due to the reduction of the solubility of aluminum in the γ matrix. Replacing chromium, molybdenum is dissolved largely in γ′ phase. The lattice constant of γ′ phase increases; the growth rate of γ′ particles decreases; aging at 760 or 925°C increases the hardness at elevated temperatures (up to 955°C); the thermal expansion coefficient decreases. The addition of molybdenum to alloys with nickel, chromium, and aluminum substantially reduces the corrosion attack at 870°C. In alloys containing titanium along with these elements, molybdenum has a negligible effect. In tests up to 980°C molybdenum reduces the damage caused by oxidation. (auth)

30127 REPLACING W WITH Mo IN HEAT-RESISTANT Co-BASE ALLOYS. Denesi, V. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 7-8, 572-573(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 7, 22-24(Jul 1973).

Results of investigations show that the addition of molybdenum instead of tungsten to cast cobalt-base alloys Mar-M-509 and FSX-414 does not lower the long-term strength or ultimate strength, increases the ductility and elongation in long-term strength tests, and lowers the density at room temperature. The thermal expansion coefficients, microstructural characteristics, and solidification are the same. (auth)

30128 RESIDUAL STRESSES IN STEEL AFTER BORIDING FROM MELTS. Babushkin, B. V.; Polyakov, B. Z. (Belorussian Polytechnical Inst., Minsk). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 7-8, 577-580(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 7, 27-30(Jul 1973).

The effects of coating composition, carbon content, and heat treatments on residual stresses in borided steel were studied. It was found that the residual stress distribution in borided steel varies with the phase composition. An increase in the carbon content of the steel leads to an increase of the residual stresses in the case of nonelectrolytic boriding and to a reduction in the case of electrolytic boriding. The highest residual stresses in the boride case result from furnace cooling from boriding temperature. Increasing the cooling rate leads to a reduction of the residual stresses. The lowest residual stresses occur after water quenching. Tempering of the borided steel increases the compressive stresses in the boride phase. Natural aging for as long as 9 months has little effect on the magnitude or distribution of residual stresses. (auth)

30129 TUNGSTEN FILAMENT AS A REINFORCING MATERIAL FOR HEAT-RESISTANT COMPOSITE MATERIALS. Banas, F. P.; Natapova, A. B.; Shegai, A. A.; Sukhanov, Yu. V. (Zaporozh'e Machine Construction Inst., USSR). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 7-8, 596-597(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 7, 45-46(Jul 1973).

Composite materials incorporating W wires in steel matrix were investigated. Data on wire and matrix composition are tabulated along with data on composite short-term strength. It is noted that the reinforcing filaments are weakened by recrystallization during prolonged use of the composite. (JRD)

30130 SOLUBILITY OF VANADIUM AND NIOBIUM NITRIDES IN IRON. Gulyaev, A. P.; Anashenko, V. N.; Karchevskaya, N. I.; Larina, O. D.; Matrosov, Yu. I. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 7-8, 643-645(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 8, 6-8(Aug 1973).

The solubility of these nitrides in pure carbonyl iron was investigated by means of phase analysis and electron microscopy. It was found that the solubility of these phases is less than 0.05 wt % at low temperatures but increases sharply with the temperature above 700°C, reaching ~0.1% for niobium nitride and 0.2% for vanadium nitride at temperatures around 1350°C. Electron microscopic analysis is a more sensitive method than phase analysis for determining the solubility of nitrides. (auth)

30131 ION BACKSCATTERING ANALYSIS OF INTERDIFFUSION IN Cu–Au THIN FILMS. Borders, J. A. (Sandia Labs., Albuquerque, NM). Thin Solid Films; 19: No. 2, 359-370(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

Helium ion back-scattering has been used to examine the interdiffusion behavior of the thin film copper–gold system. Techniques for distinguishing bulk diffusion and grain boundary diffusion using back-scattering are presented. At temperatures in the range 200 to 500°C, the grain boundary diffusion mechanism is shown to predominate in Cu–Au thin films. The back-scattering results suggest a model in which interdiffusion takes place by very rapid saturation of the grain boundaries in the gold film by copper and a slower filling of the copper grain boundaries by gold. The atoms in the grain boundaries then diffuse into the grains by bulk diffusion. It is suggested that in the parent gold film the amount of $CuAu_3$ formed near the grain boundaries is uniform in depth. In the parent copper film, more Cu_3Au forms near the original Cu–Au interface than further into the copper film. No evidence was found to suggest the formation of a pure layer of $CuAu_3$ or Cu_3Au. The interdiffusion and compound formation process is found to be characterized by an activation energy of 1.35 to 1.5 eV. (auth)

30132 LOW-TEMPERATURE INTERDIFFUSION IN COPPER–GOLD THIN FILMS ANALYSED BY HELIUM BACKSCATTERING. Campisano, S. U.; Foti, G.; Grasso, F.; Rimini, E. (Univ., Catania, Italy). Thin Solid Films; 19: No. 2, 339-348(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

The technique of back-scattering MeV helium ions has been applied to the study of the interdiffusion behavior of bimetallic Cu–Au thin films. The films were annealed for up to 210 min at 170 to 300°C. A rapid initial mixing was detected for all the temperatures investigated and was attributed to the large density of structural defects present in an evaporated film. The plateaus exhibited in the copper and gold energy spectra suggest the appearance of $CuAu_3$ as a first phase and then of CuAu and Cu_3Au phases. The interdiffusion coefficient was measured from the gold concentration profiles for gold atomic concentrations in the range 25 to 0% and a value of 2.5×10^{-15} cm²/s at 220°C was obtained. An activation energy of 1.4 eV was estimated for this process. (auth)

30133 ROLE OF GRAIN SIZE DURING WORK HARDENING OF G13 STEEL CONTAINING NIOBIUM. Novomeiskii, Yu. D.; Raskolenko, L. G. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 130-132(1973). (In Russian).

The effect of grain size on the yield point and hardening of G13 steel with Nb content up to 1.1 wt % is studied. Analysis of the data showed that the contribution of the different hardening mechanisms (alloying of the solid solution, precipitation, and size reduction of the grain) are additive. The contribution of grain size reduction to hardening approaches saturation in the concentration range of 0.3 to 0.5 wt % Nb. (JSR)

30134 MATERIALS OF THE SOVIET–AMERICAN SYMPOSIUM ON NEW DEVELOPMENTS IN STEELS AND ALLOYS WITH Mo. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 7-8, 545(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 7, 2(Jul 1973).

The Soviet–American symposium on new developments in steels and alloys with molybdenum was held January 17–19, 1973, at the I. P. Bardin Central Scientific-Research Institute of Ferrous Metallurgy. The symposium was attended by representatives from the Climax Molybdenum Company (USA) and representatives from scientific-research institutes and factories (USSR). Ten American reports and seven Soviet reports were given concerning the effect of molybdenum on the properties of steels and alloys and the use of various steels and alloys with molybdenum. Molybdenum is one of the basic alloying elements in steels and alloys and its effects on the properties are being investigated in both the United States and the USSR. In the interest of scientific-technical cooperation between the USSR and the United States the reports of the American scientists are published. (auth)

30135 INTERDIFFUSION OF THE Nb–Zr SYSTEM. Ronami, T. N.; Gryzunov, V. I. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 3, 367-369(1973). (In Russian).

The interdiffusion in the Nb–Zr system was studied by the method of local x-ray analysis of diffusion layers obtained by annealing in the temperature interval from 400 to 1700°C with subsequent quenching. The phase diagram of the system was made more precise. Some diffusion parameters of the system were calculated from the given distribution of the elements Nb and Zr. (JSR)

30136 ANOMALY IN SPECIFIC HEAT OF HfV_2 AND ZrV_2 AT LOW TEMPERATURES. Kimura, Y. (Electrotechnical Lab., Tokyo). J. Phys. Soc. Jap.; 36: No. 1, 306(Jan 1974).

30137 BACKSCATTERING INVESTIGATION OF THE LOW-TEMPERATURE STABILITY OF THE ALUMINUM–SILVER SYSTEM. Westmoreland, J. E.; Weisenberger, W. H. (Naval Research Lab., Washington, DC). Thin Solid Films; 19: No. 2, 349-358(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

The large angle elastic scattering of 2.9 MeV $^4He_2$ was used to investigate the Al–Ag system. This system has important optical applications and affords an opportunity to study directly chemical kinetics. Heretofore, only indirect measurements of the system have been made. The samples consisted of thick Si substrates covered by a 5000 Å thermal SiO_2 layer. Then 2000 Å Al and 3000 Å Ag films were deposited in both sequences without raising the system vacuum above $\sim 2 \times 10^{-5}$ torr. The backscattering measurements were performed after each step of a sequence of isothermal annealing treatments at ~135°C for times up to 6 h. This study shows that the Si–SiO_2–Al–Ag system is stable after such a treatment. Thus, for Al first depositions, no intermediate metal is necessary for a diffusion barrier at room temperature. Indirect evidence is presented which suggests that the acting diffusion barrier in the Al first depositions is probably the thin natural aluminum oxide layer expected to be formed for the deposition conditions used. However, the adherence of these films to one another is shown to require further characterization if high bonding values are required. By comparison in Ag first depositions, extensive intermixing of the Al and Ag has occurred after as little as 105 min at 135°C. The backscattering measurements correlated with the previous reflectivity measurements suggest that the interdiffusion of Ag and Al without significant compound formation plays a significant role in at least the initial changes in the reflectivity of thin films of Ag and Al. Finally, this study shows that a 500 Å Cr deposition between the Ag and Al depositions serves as an adequate diffusion barrier after an anneal treatment of 60 min at 300°C. (auth)

30138 MOESSBAUER STUDIES OF Er IMPURITIES IN THE CUBIC ACTINIDE METAL Th. Stoehr, J. (Technische Univ., Munich); Wagner, W.; Shenoy, G. K. Phys. Lett.; 47A: No. 2, 177-178(11 Mar 1974).

The hyperfine coupling of the 4f-conduction electron exchange interaction of localized Er moments in Th have been investigated by Moessbauer spectroscopy. The results are compared with previous studies of Er impurities in Au and Ag. (auth)

30139 HYPERFINE FIELD AT ^{181}Ta NUCLEI IN FERROMAGNETIC $ZrZn_2$. Barrett, J. S.; Cameron, J. A. (McMaster Univ., Hamilton, Ont.). Phys. Lett.; 47A: No. 2, 163-164(11 Mar 1974).

A sample of $ZrZn_2$ containing 2% Hf has been studied by differential perturbed angular correlations of the gamma rays of ^{181}Hf. A value of -15.1 ± 0.6 kOe was found for the hyperfine field at the ^{181}Ta nuclei. (auth)

30140 NUCLEAR IRON MAKING. Ota, S. (Kobe Steel, Ltd., Japan). Kinzoku Zairyo; 13: No. 5, 31-36(May 1973). (In Japanese).

In the process of nuclear iron making, development of materials to be used in components subject to exposure to He at 1000°C,

such as heat exchangers, steam reforming furnaces, and pipes are discussed. The criterion of usability is set at 1 kg/mm² as a limit of failure. For heat exchanger pipe material: up to 900 to 950°C, following materials are recommended Incoloy 800, and 807; Inconel 600, 601, 625, 617, and Hastelloy X; over 950°C, it is necessary to develop new material. For reformer tube: centrifugal casting pipe HK40 is employed, but there is a drawback in that the diameter is small. Extruded pipe having composition identical with that of HK40 to which continuous grain forming treatment is applied has been developed. For pipes: double- or triple-layer pipe is employed and Incoloy, Inconel, Hastelloy are used for inner tube in which high temperature He passes. In this case, development of heat insulating material becomes important. Problems for development are as follows: deterioration of materials by small amounts of impurities in He, hydrogen diffusion in He, introduction of hot powder extrusion to piping work, and improvement of welding rod and establishment of welding conditions. Concerning the improvement of the materials it is necessary to discuss in the broader fields including manufacture, design, practice and use. (JA)

30141 PERMEATION OF HYDROGEN ISOTOPES THROUGH STRUCTURAL METALS AT LOW PRESSURES AND THROUGH METALS WITH OXIDE FILM BARRIERS. Strehlow, R. A.; Savage, H. C. (Oak Ridge National Lab., TN). Nucl. Technol.; 22: No. 1, 127-137(Apr 1974).

The permeation and its pressure dependence of hydrogen isotopes through metals and oxidized metals were studied at 300 to 800°C and 10^{-3} torr to 1 atm. The metals studied included nickel, Type 304 L stainless steel, Hastelloy N, Incoloy 800, Croloy T9, Croloy T22, and Type 406 stainless steel. Deuterium, rather than normal hydrogen, was used as the permeating gas in order to achieve high sensitivity in the mass spectrometric analyses. At a given temperature, the permeation rate of deuterium through metals that are substantially free of oxide films was found to proceed with a half-power pressure dependence in accordance with the relationship $J = K(P_1^{\frac{1}{2}} - P_2^{\frac{1}{2}})$, where J is the permeation flow rate, K is a constant, and P_1 and P_2 are the upstream and downstream gas pressures, respectively. The rates of the permeation of deuterium through oxidized metals were usually lower than through unoxidized metals and the observed pressure dependence was frequently greater than the half-power. For some alloys, a reduction in permeation rate by a factor of a hundred or more at 1-atm pressure was observed; the reduction at low pressures was even greater. The observations made are consistent with considerations of the chemical stability of the oxide and of the presence of cracks or other imperfections in the oxide film. (6 figures) (auth)

30142 HEAT EXPANSION OF TWO-PHASE TEXTURED MATERIALS. Kozlova, R. F.; Rabkin, V. B. Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 54-59(Feb 1974). (In Russian).

On the basis of metallographic observations of the structure of Mo–Cu–Ni compositions in the strained state and investigation of changes in their thermal expansion coefficient (TEC), four stages in deformation of the molybdenum phase grain are detected. An empirical equation is derived, permitting the TEC domains of intensivity to the blank deformation to be determined and the values of the TEC of compositions to be estimated at the active stage of the deformation. (auth)

30143 THERMAL PROPERTIES OF REFRACTORY METALS. Filippov, L. P.; Trukhanova, L. N.; Makarenko, I. N.; Arutyunov, A. V. pp 51-56 of Teplofizicheskie Svoistva Tverdykh Veshchestv. Samsonov, G. V. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

New experimental data are presented on the thermal properties of refractory metals, including Hf, Re, V, Mo, W, Nb, Ta, and Zr. These data are the summary of the results of 12 studies on the thermal properties of the metals. The basic principles of the behavior of thermal capacity and thermal conductivity at high temperatures are discussed. (tr-auth)

30144 EXPERIMENTAL STUDY OF ENTHALPY OF MOLYBDENUM IN THE SOLID AND LIQUID STATES. Chekhovskoi, V. Ya.; Berezin, B. Ya. pp 128-134 of Teplofizicheskie Svoistva Tverdykh Veshchestv. Samsonov, G. V. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

An experimental method is described for measuring the enthalpy of refractory metals by displacement on an assembly with electromagnetic levitation and simultaneous intensive heating of samples in a high-frequency electromagnetic field. The equipment was tested at temperatures above 2000°K in a vacuum and in argon with inductors of different construction and samples of different weight and shape. The enthalpy of solid molybdenum, recommended as the sample substance, was measured by calorimetry in the temperature range above 1000°K. (tr-auth)

30145 INVESTIGATION OF INTERACTION ON THE PHASE INTERFACE IN COMPOSITE MATERIALS WITH NICHROME MATRIX AND FIBRES ON TUNGSTEN AND MOLYBDENUM BASE. Karpinos, D. M.; Fedorenko, V. K.; Burykina, A. L.; Gorskii, V. V. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 64-75(Feb 1974). (In Russian).

The structure and phase composition of the fiber–matrix transition zones is studied by means of metallographic microdurometric analyses and x-ray spectrum microanalysis. It is found that the thickness, structure, and phase composition of the interaction zones are determined by temperature–time conditions during the annealing. The diffusion coefficients are calculated by the Matano method and their dependence on the concentration of contacting pair elements is found. The law of diffusion layer growth is investigated in composite materials on the base of nichrome matrix and tungsten and molybdenum fibers. The mechanism of diffusion processes is elucidated. The degree of the effect of the matrix and fiber alloying elements on recrystallization kinetics of reinforcing elements is studied. The effect of the fibers matrix interaction on the bond strength between contacting elements is examined. (6 figures) (auth)

Radiation Effects

Refer also to abstracts 31056–31058, 31154, and 31403.

30146 (AD-763658) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, 1 February–30 Apr 1973. Steele, L. E. (Naval Research Lab., Washington, D. C. (USA)). 15 May 1973. 58p. (NRL-MR-2595). NTIS $3.00.

The research program of the NRL Metallurgy Division, Reactor Materials Branch, involves a broad study of the effects of nuclear radiation on materials. The report covering research for the period 1 February to 30 April 1973, and includes: the effect of hold time on fatigue crack propagation in 20% cold worked stainless steel; the effect of implanted helium on fatigue behavior of TZM alloy; radiation enhanced metastability in a high strength structural alloy, the AEC-CE-NRL Cooperative program on A533-B reactor vessel steel; the transition temperature increase for the SM-1A pressure vessel at reactor shutdown; J-integral characterization of the SM-1A reactor pressure vessel steels; the effect of water vapor on the fatigue strength of irradiated Type 348 stainless steel; and the effect of beam scanning on void formation in nickel-ion bombarded nickel. (GRA)

30147 (AI-AEC-13123) PROTON RANGE AND ENERGY IN IRRADIATED TYPE 316 STAINLESS STEEL. KEEFER, D. W.; Pard, A. G. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Mar 1974. Contract AT(04-3)-824. 17p. Dep. NTIS $4.00.

Cross-section transmission-electron-microscope foils of Type 316 stainless steel were used to determine the depth to which voids are formed during proton irradiation at energies between 0.75 and 1.05 MeV. These void depths, which can be determined with an accuracy of ±5%, were found to exceed by a rather large amount ($\sim 10^{-4}$ cm) the results from range–energy data tables prepared specifically for stainless steel. Experimental and microstructural features which could lead to this apparent discrepancy are discussed. It is concluded that the depth to which voids are formed gives a good measure of the proton range at a particular energy. Values of calculated proton energy vs penetration which best agree with the experimental depth data are presented. (auth)

30148 (CEA-CONF-2488) ZENER RELAXATION ASSOCIATED WITH VACANCY SUPERSATURATIONS UNDER A FAST PARTICLE FLUX. Halbwachs, M.; Hillairet, J.; Bisogni, E. A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). [nd]. 10p. (CONF-730844-6). Dep. NTIS (U. S. Sales Only) $3.00.

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973).

Zener relaxation was used to study vacancies under dynamic equilibrium conditions. An Ag–27 at. % Zn alloy was first studied under electron bombardment (3×10^{16} e/cm² · s) and varying dislocation densities. Ag–30 and 27 at. % Zn alloys were also exposed to various fast neutron fluxes, and in-pile internal friction measurements were made. Results are contradictory, but a vacancy supersaturation as high as 10^4 at 400°K (0.4 T_m) was inferred. (DLC)

30149 (COO-3158-28) DEFECTS IN METAL CRYSTALS. Progress Report, May 1, 1973–April 30, 1974. Balluffi, R. W.; Seidman, D. N. (Cornell Univ., Ithaca, N. Y. (USA)). 1974. Contract AT(11-1)-3158. 22p. Dep. NTIS $4.25.

Progress was made in the following areas: FIM (field ion microscopy) studies of defects in W irradiated with W ions or electrons; FIM studies of Au irradiated with Au or Xe ions; FIM and electrical resistivity study of vacancy defects in quenched W; FIM studies of dilute Pt alloys; measurement of the range of focused replacement sequences in Au; investigation of grain boundary structure (using Au); FIM observation of dissociated screw dislocations in Mo; calculation of properties of point defects in metals; and atom probe FIM. (auth)

30150 (HEDL-TME-71-51) MEASUREMENT OF NUCLEAR DECAY HEATING OF TANTALUM SPECIMENS IRRADIATED IN THE EBR-II. Straalsund, J. L.; Dahl, R. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1971. Contract AT(45-1)-2170. 22p. Dep. NTIS $4.25.

A calorimetric test was conducted to measure self-heating in specimen of tantalum which had been irradiated in the EBR-2. Results can be reconciled with FFTF design basis only if flux depression and self-shielding reduce the activity to 40% of that which would be calculated assuming an unperturbed flux and an infinitely dilute absorber. Since the reduction is substantiated by preliminary calculations, it is concluded that this experiment verifies the methods used to evaluate Ta after-heat in the FFTF, provided that estimates of self-shielding and perturbation are properly considered in FFTF design. (auth)

30151 (JPRS-60560, pp 162-168) INFLUENCE OF RADIATION ON THE WORKING CAPACITY OF STAINLESS STEELS. Maslenik, I. S.; Maksimova, E. S. 16 Nov 1973. Translated from pp 178-184 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

A generalization is made of the principal indicators of working capacity of construction materials for reactors. Effects of reactor irradiation on the long-term strength and plasticity of Type 304 stainless steel at 650°C. Recommendations are made for experimental studies on the working capacity of new stainless steels under reactor conditions. (24 references) (DLC)

30152 (NRL-7660) AUGER ELECTRON SPECTROSCOPY ANALYSIS OF THE FRACTURE SURFACES OF IRRADIATED PRESSURE-VESSEL STEELS. Smidt, F. A. Jr.; Stein, D. F.; Joshi, A. (Naval Research Lab., Washington, D. C. (USA)). 21 Dec 1973. Contract AT(49-5)-2110. 12p. Dep. NTIS $4.00.

Pressure-vessel steels and weldments containing the residual elements Cu and P show a marked tendency toward embrittlement after irradiation at 290°C. Auger electron spectroscopy was used to analyze fracture surfaces of these materials to ascertain if segregation of Cu and P during irradiation was responsible for the embrittlement. No evidence of segregation was found. An alternative mechanism is suggested in which the residual elements modify the defect microstructure, with attendant increases in yield strength and ductile-to-brittle transition temperature. (auth)

30153 SIMULATION OF THE BOMBARDMENT OF METALS WITH HEAVY IONS AT HIGH ENERGIES. Dang Dinh Cung. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 9-10(1973). (In French).

Computer simulations were made of the bombardment of Fe, Cu, W, and Au with atoms of the same nature for initial energies ranging from 20 to 350 keV. Where comparisons were possible, no disagreement was found with experimentally obtained results. (FR)

30154 ORDER OF CAVITIES IN Mg AND Al IRRADIATED WITH FAST NEUTRONS. Risbet, A.; Levy, V. (CEN, Saclay, France). J. Nucl. Mater.; 50: No. 1, 116-118(Feb 1974).

An imperfect order of cavities was detected in neutron-irradiated Al and Mg. In the Mg irradiated at 3×10^{21} n/cm^2, a one-dimensional order was observed in the distribution of cavities. They are located in the (0001) plane almost equidistant from each other. In Al irradiated at 6×10^{21} n/cm^2, the cavities have a tendency to form alignments. An analysis on the orientation plane led to the conclusion that the cavities form a very imperfect fcc lattice parallel to the Al lattice. Of the models proposed to explain the ordering of the cavities, only those based on elastic interactions between cavities are justified by the observations. (JSR)

30155 OXIDATION BEHAVIOR OF HIGHLY IRRADIATED U IN CO_2 AT 375 TO 500°C AND IN DRY AIR AT 200 TO 300°C. Bennett, M. J.; Myatt, B. L.; Antill, J. E. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater.; 50: No. 1, 2-10(Feb 1974).

The influence of irradiation of adjusted uranium, to a burnup of 6400 MWd/t, was studied upon its reactivity out-of-reactor in carbon dioxide at 375-500°C and in air at 200-300°C. In the absence of appreciable swelling, the irradiation increased the attack in carbon dioxide and air by factors of only 1-8 and 1-2 respectively. With swollen metal, the attack increased with swelling, without any notable dependence of the enhancement factor on the environment. Thus, the enhancement factor was ≈100 with a swelling of 50% and had a maximum value of 1000-2000 for 120% swollen material. The pore structure of swollen uranium was established by BET surface area and density measurements to be primarily closed. Consequently, the enhanced reactivity was not due to access of the gas to the internal surface area and is attributed to break-up of the metal surface during oxidation. (6 figures, 3 tables) (auth)

30156 DEFORMATION OF NEUTRON-IRRADIATED COPPER ALLOYS. Sharp, J. V. (Atomic Energy Research Establishment, Harwell, Eng.). Acta Met.; 22: No. 4, 449-457(Apr 1974).

The deformation behavior of three different irradiated copper alloys has been investigated using mainly transmission electron microscopy. These alloys are copper–0.8% cobalt single crystals (containing equiaxed precipitates of diameter ~930 Å), internally oxidized copper–0.05% aluminum crystals (containing a higher density of smaller particles, diam. ~450 Å), and single phase Cu–4% Al single crystals; these have been irradiated at ambient temperature to a dose of 10^{18} n/cm^2. Cleared channels are formed during deformation in the Cu–Co and Cu–Al_2O_3 crystals, whereas the dislocations are confined to a few slip planes in the irradiated Cu–4% Al crystals. In both Cu–Co and Cu–Al_2O_3 crystals some dislocations bypass the particles by cross slip although most of the dislocations shear through the precipitates in the Cu–Co crystals producing large elongations along the slip direction. In contrast there is no evidence for particle shearing in the Cu–Al_2O_3 crystals and high local densities of primary and secondary dislocations are associated with the particles, together with the formation of some cavities. The results are compared with those for deformed irradiated copper crystals and unirradiated copper alloys and assessed in terms of the model which has been previously developed for the deformation of neutron irradiated copper crystals. (auth)

30157 RADIATION ANNEAL HARDENING IN MOLYBDENUM. Hasson, D. F. (Naval Academy, Annapolis, MD); Arsenault, R. J. Phys. Status Solidi (a); 22: No. 1, 39-43(16 Mar 1974).

Yield stress measurements were performed on irradiated and annealed-irradiated high-purity (5 wt ppM interstitials) and intermediate-purity (27 wt ppM interstitials) Mo single crystals of (100), (110), and (491) orientations. Radiation anneal hardening which is the additional increment in yield stress over that observed in irradiated samples was observed for all orientations. Radiation anneal hardening was smaller in samples with the higher impurity interstitial concentration. The proposed mechanism, therefore, for the observed anneal hardening is the migration of self interstitials to the radiation produced defect clusters. (auth)

30158 TEM INVESTIGATION OF 14-MeV NEUTRON DAMAGE. Merkle, K. L. (Argonne National Lab., IL). Nucl. Technol.; 22: No. 1, 66-74(Apr 1974).

Using transmission electron microscopy, 14-MeV damage was investigated in gold. The sites of energetic displacement cascades are visible because of the presence of vacancy clusters formed by the collapse or rearrangement of vacancies within the depleted zones. A strong tendency toward subcascade formation was found in the 14-MeV neutron-induced cascades. On the average, 1.8 clusters are formed per cascade. Individual cascades with as many as six subcascades have been found. The number densities of clusters and cascades are proportional to the fluence. The cross section for the formation of visible cascades is $\sigma_c = 3.3 \times 10^{-24}$ cm^2. It can be shown that recoils from elastic neutron-scattering events can account for <20% of the visible cascades. The cross section corresponding to the balance of the observed cascades is, within experimental error, equal to the nonelastic neutron-scattering cross section. This indicates that all nonelastic-scattering events lead to the formation of a visible cascade. Quantitative agreement is found with what is expected from heavy-ion bombardments regarding the cross sections involved; however, estimates of the average cascade energy in the 14-MeV neutron bombardments are somewhat higher than expected. (10 figures, 36 references) (auth)

30159 STABILITY OF THE DEFECT STATE IN NEUTRON-IRRADIATED MOLYBDENUM. Sikka, V. K.; Moteff, J. (Univ. of Cincinnati). Contract AT(11-1)-2093. Nucl. Technol.; 22: No. 1, 52-65(Apr 1974).

The thermal stability of neutron-induced defects in Mo irradiated in EBR-II to a fast-neutron fluence of $\sim 1 \times 10^{22}$ n/cm^2 (E > 1 MeV) clearly suggests that there are critical temperature regimes that

should be avoided by reactor design engineers. These regions are manifested by a rapid change in the microstructure within a small temperature interval, a circumstance that can significantly influence the strength and corresponding ductility of the material. One critical temperature occurs at ~800°C, where the irradiation-induced modulus-corrected strength could vary significantly compared to unirradiated molybdenum for a small temperature variation around 800°C. Voids have been shown to occur in specimens irradiated at 430, 580, 700, 800, 900, and 1000°C; these voids are stable at temperatures up to ~0.60 T_m, rather than the 0.55 T_m value reported earlier for low fluence irradiations. The increase in the complete void removal temperature is suggested to exist due to the presence of a larger void size and the ordered void lattice structure in EBR-II samples. (7 figures, 3 tables) (auth)

30160 IMPURITY REDISTRIBUTION AROUND VOIDS IN ION-BOMBARDED VANADIUM. Okamoto, P. R.; Santhanam, A. T.; Wiedersich, H.; Taylor, A. (Argonne National Lab., IL). Nucl. Technol.; 22: No. 1, 45-51(Apr 1974).

Recent transmission electron microscopy examinations of heavy-ion-bombarded vanadium have shown that the peak swelling temperature was sensitive to impurity content. In addition, anomalously large strain fields were observed around voids at 650°C. At higher temperatures, thin precipitates were observed to form on void surfaces. These strain and precipitate effects are shown to be caused by impurity segregation to void surfaces during irradiation. (auth)

30161 NEUTRON-IRRADIATION TESTS FOR STEEL WIRES FOR PRESTRESSED CONCRETE REACTOR PRESSURE VESSEL. Shimokawa, K. (Nippon Steel Corp., Tokyo). Tetsu To Hagane; 59: No. 2, 335-348(Feb 1973). (In Japanese).

The neutron irradiation tests for wires used in prestressed concrete (PC) are required to determine effects on their property change, especially prestress, when prestressed concrete pressure vessels will be adopted in the construction of large atomic power plants and the introduction of high temperature gas cooled reactors, in Japan in near future. The post-irradiation method with a piezoelectric element was employed for the measurement of relaxation. Since the measurement during irradiation has difficulties in the temperature compensation of gages, immersion of detector parts in cooling water, and discernment of the irradiation effects on relaxation data, the post-irradiation method was employed. The capacity of a load cell was 5 tons, its accuracy was ±5%, and feed speed of test pieces was 3 mm/min. 5.0 mm ϕ chromium and nickel plated steel wires were employed as specimens. The irradiation was carried out with sealed capsules and M-12 irradiation holes, in 6 irradiation cycles, at neutron energy level of higher than 1 MeV, with monitor cross section 6_P (n,p) = 77 mb, and at irradiation temperature of 38°C in the JMTR reactor. The results of testing 5 mm ϕ PC steel wires with neutron beam of 6.9×10^{19} n/cm^2 are as follows: (1) the relaxation data on six carbon steel PC wires and one oil-tempered low-alloy steel wire (sup-9) show that every data reduced after 25 h in the range from 0.16% to 1.06% or 0.57% in average; (2) tensile test on two carbon steel PC wires shows that tensile strength and 0.2% proof stress increased, and elongation decreased a little; and (3) irradiation dose of 6.9×10^{18} n/cm^2 neutrons may exert embrittling influence on the specimens. (JA)

30162 ION SCATTERING FROM SINGLE CRYSTALS. Martynenko, Yu. V. (Inst. of Atomic Energy, Moscow). Radiat. Eff.; 20: No. 3, 211-214(Nov 1973).

Ion scattering from an atomic chain is theoretically treated. Maximum and minimum scattering angles, location, width, and intensity of peaks in the energy spectrum of scattering ions are calculated. The results are in general agreement with those of experiments and computer simulation. (auth)

30163 THRESHOLD ENERGY FOR ATOMIC DISPLACEMENTS IN LEAD. Borton, D. N. Troy, NY; Rensselaer Polytechnic Inst. (1973). 76p. University Microfilms Order No. 74-5134.

Thesis (Ph. D.).

Electron irradiation of 16-μm thick, 99.9999% nominal purity lead samples yields a threshold energy for atomic displacements in lead of 15 ± 1 eV. The radiation damage, near liquid helium temperatures, is monitored by changes in electrical resistivity measured by standard potentiometric technique. The damage rate as a function of electron energy from 0.7 to 1.4 MeV is compared to calculated displacement cross sections to determine the threshold energy. From the calculated cross section and the damage rate data, the resistivity of a 1% concentration of Frenkel defects is found to be greater than 1 $\mu\Omega$ cm. The damage rate is found to be dependent on the temperature of irradiation and may be as much as a factor of three too small due to annealing that takes place during the irradiation. The resistivity of a 1% concentration of Frenkel defects may be as much as 3 $\mu\Omega$ cm. Annealing studies performed to find the cause of the temperature-dependent damage rate found Stage IE annealing near liquid helium temperature and greater than 40%, of the radiation damage induced at 5°K, annealed by 20°K. Previous authors (Papastaikoudis, 1970) found less than 10% of the damage they created at 7°K annealed by 100°K. They claim Stage ID is near 170°K. (Diss. Abstr. Int., B)

Other Materials

Refer also to abstracts 29114, 29119, 29121, 29566, 29994, 31638, 31640, 31643, 31644, 31648, 31657, and 31660.

30164 (AD-767671-1-GA) ELASTIC-PLASTIC ANALYSIS OF UNIDIRECTIONAL COMPOSITE UNDER LONGITUDINAL SHEAR. Wechselberger, J. F. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1973. 97p. NTIS $7.00.

Thesis.

The failure point of a undirectional composite subjected to longitudinal shear loading is calculated. The method of analysis is based on the finite element technique, the incremental plasticity relations of Prandtl-Reuss, and the von Mises yield criterion. The failure point for a boron-aluminum composite and a boron-epoxy composite were computed to determine the effect of the matrix material on the composite. (GRA)

30165 (HW-84556) ROVER GRAPHITE STUDIES. Quarterly Progress Report, July-September 1964. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 15 Oct 1964. Contract AT(45-1)-1350. 10p. Dep. NTIS $4.00.

Declassified 28 Aug 1973.

U migration through pyrolytic C was studied. Crystallite orientations in fueled and unfueled graphite were determined. The reaction between Nb and graphite was investigated at 1600 and 1900°C. Bonding of fueled to unfueled graphite by magnetic force welding was demonstrated. (DLC)

30166 DYNAMICS OF POSITIVE-ION VACANCIES IN X-IRRADIATED NaCl BY POSITRON ANNIHILATION. Brandt, W.; Paulin, R. (Institut National des Sciences et Techniques Nucleaires, Saclay, France). Phys. Rev., B; 8: No. 9, 4125-4133 (1 Nov 1973).

A fraction of thermalized positrons in a NaCl crystal can be trapped in crystal defects to form annihilation or A centers. This fraction is found to increase after x irradiation of the crystal. The increase is measured through the coincidence count rate of the two 0.51-MeV positron-electron-annihilation γ quanta emerging from NaCl single crystals in exactly opposite directions. Isothermal annealing at various temperatures T between 55 and 185°C always increases the count rate further, in time intervals ranging, respectively, from 10^2 to 10 min. When T > 100°C, the count rate as a function of time passes through a pronounced maximum and diminishes slowly (in 10^3 to 10^4 min) toward the count rate of the annealed crystal. The activation energy for the rate of increase is 0.4 eV, and for the decrease 1.2 eV. Both values coincide with the activation energies for the rise and decline of the ionic conductivity in isothermal anneals at T ≥ 130°C. To the extent that the dominant A centers are positrons trapped in mobile or immobile positive-ion vacancies, and that the dominant charge carriers in ionic conductivity are the mobile positive-ion vacancies, our data support the long-held conjecture that x-irradiation creates vacancies and that during incipient periods of annealing additional vacancies are released from radiation-induced vacancy aggregates. The positive-ion vacancy-diffusion constant is deduced to be 2×10^{-11} cm^2/sec, corresponding to a mobility ~10^{-9} cm^2/V sec, by Einstein's relation. The ubiquitous initial rise in our count rates implies that the initial drop in conductivity for isothermal anneals at moderate temperatures, T ≲ 100°C, is caused not by the neutralization of positive-ion vacancies but by their immobilization through complex formation. The decline at long anneal times in both our count rates and the conductivities, with identical activation energies, signifies the slow formation of positive-ion-vacancy sinks leading to the complete annealing of the radiation-induced defects so observed. (auth)

30167 IRRADIATION SWELLING IN OX16H15M3B STEEL. Bykov, V. N.; Vakhtin, A. G.; Dmitriev, V. D.; Kostromin, L. G.; Ladygin, A. Ya.; Shcherbak, V. I. At. Energ. (USSR); 36: No. 1, 24-26(Jan 1974). (In Russian).

Electron microscopy has been used to study void formation in OX16H15M3B stainless steel irradiated in a BR-5 reactor to fluences up to $4.3\ 10^{22}$ n · cm^{-2} in the temperature interval 430 to 580°C. The effects of fluence and irradiation temperature on the total amount of swelling, void size and void density are discussed. (tr-auth)

30168 ELECTRIC CONDUCTIVITY OF CaF_2 CRYSTALS WITH PRELIMINARY IRRADIATION AND THERMAL DISCOLORATION. Lisitsyn, V. M.; Morgunov, V. L.; Fedorov, V. A. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 115-118(1973). (In Russian).

Pure CaF_2 crystals were irradiated with 4.5-Mev protons or 1.2-Mev electrons at temperatures no higher than 30°C. The measurement of the electric conductivity was made from room temperature up to 500°C The thermoluminescence of the crystals was measured simultaneously. Analysis of results showed that the bond of the current carriers responsible for the conductivity of the irradiated and then thermally discolored crystals to the lattice is very weak. The concentration of current carriers increases with dose of preliminary radiation up to 5×10^9 rad. The temperature dependence of the conductivity and thermoluminescence of the CaF_2 crystals was shown. The mechanism for the change of the conductivity was outlined. (JSR)

30169 STUDY OF DEFECTS PRODUCED IN GaAs BY THE IMPLANTATION OF Zn^+ IONS (1 MeV) USING CHANNELING. Guivar'ch, A.; L'Haridon, H. (Centre National d'Etudes des Telecommunications, Lannion, France). J. Phys. (Paris), Colloq.; No. 5, 119-124(1973). (In French).

From Centenary Congress of the French Physical Society; Vittel, France (28 May 1973).

Studies of the depth profiles of lattice disorder due to the bombardment of monocrystals have many applications. The high angle backscattering of channeled 1.5 MeV He^+ ions was used to study the distribution of diffusion centers produced by the implantation of 77 K Zn^+ ions (1 MeV) in GaAs. The backscattering spectra were analyzed using the Keil and Meyer multiple scattering calculations and the Ziegler linear approximation. The Keil and Meyer calculations, which have already been verified for evaporated Ge layers, do not yield very convincing results for the spectra considered: the scattering undergone by the ions of the analyzing beam is not the same for a damaged zone as for an amorphous film. The peak and the width of the damage distribution are in good agreement with theoretical calculations of Sigmung and Sanders for the profile of the energy deposited by ions in solids. (FR)

30170 EFFECT OF IRRADIATION ON CARRIER MOBILITY IN INVERSION LAYERS OF MOS STRUCTURES. Girii, V. A. (Inst. of Physics, Kiev); Kondrachuk, A. V.; Kornyushin, S. I.; Litvinov, R. O.; Shakhovtsov, V. I. Phys. Status Solidi (a); 22: No. 1, 357-362(16 Mar 1974).

The effect of irradiation on the carrier mobility in inversion channels of MOS structures of thermally grown SiO_2 as a function of band bending Y_s and temperature T is studied. Possible physical models which explain the decreasing of carrier mobility both on the left- and right-hand side of the maximum of the $\mu_{s\,eff}(Y_s$ -dependence are discussed. New data on the formation of fast surface states at the Si/SiO_2 interface by different types of irradiation are given. (auth)

30171 EPR OF CONDUCTION ELECTRONS PRODUCED IN Si BY HYDROGEN-ION IMPLANTATION. Gorelkinskii, Yu. V.; Sigle, V. O.; Takibaev, Zh. S. (Inst. of High Energy Physics, Alma-Ata, USSR). Phys. Status Solidi (a); 22: No. 1, K55-K57 (16 Mar 1974).

N- and p-type (P and B-doped) Si was implanted with 4×10^{17} ions/cm^2 of 6-MeV H^+ and 12-MeV D^+. The ion implantation produced EPR spectra; annealing of the paramagnetic damage centers occurs between 200 and 350°C and of conduction electrons at 350°C. The electron concentration becomes maximum (20% of all implanted ions) after annealing at 475°C. It is concluded that implantation of H^+ and D^+ into Si will form Si–H bonds, associated with radiation defect centers which produce shallow donors. Annealing at 500°C breaks these bonds. (DLC)

30172 EXPERIMENTAL VERIFICATION OF KLEINMANN SYMMETRY CONDITIONS IN γ-IRRADIATED ADP CRYSTALS. Kuczynski, W. (Inst. of Physics, Poznan, Poland). Phys. Status Solidi (a); 22: No. 1, K113-K115(16 Mar 1974).

Changes in the nonlinear electrical susceptibility tensor elements are discussed, which were determined by comparing the Maker's fringes from the second harmonic of light generation. The dose was varied from 50 to 1500 R. After ~100 R, the quality of the crystal improves, and the Kleinmann symmetry conditions are fulfilled more satisfactorily (d_{14}/d_{36} reaches 1.0). (DLC)

30173 THERMOLUMINESCENCE OF ELECTRON-IRRADIATED CaF_2. Rao, D. R. (Inst. of Tech., Kharagpur). Phys. Status Solidi (a); 22: No. 1, 343-349(16 Mar 1974).

Storage of excitation energy in CaF_2 crystals, irradiated by low-energy electrons, is found to be very much less compared to x-ray irradiation; the TL (thermoluminescence) yield is, in general, very poor for all the temperatures of excitation between 300 and 500°K. While the crystal, excited by electrons at RT, shows a complex distribution of glow maxima in the temperature region between 300 and 700°K, it does not seem to show any TL for excitation at about 500°K or above; in the latter case the crystal becomes densely colored and shows α and β absorption bands. The comparatively low intense glow peaks occurring below 500°K may be associated with the trapping states related with the trace impurities. Absence of TL in the colored crystal is explained by assuming that, during the process of excitation at or above 450°K trapped holes diffuse away from the affected layer and facilitate the formation of α and β absorption bands. (auth)

30174 CRYSTAL AND MAGNETIC STRUCTURE OF UPTe AND UAsTe STUDIED BY NEUTRON DIFFRACTION. Zygmunt, A. (Inst. for Low-Temperature and Structure Research, Wroclaw); Murasik, A.; Ligenza, S.; Leciejewicz, J. Phys. Status Solidi (a); 22: No. 1, 75-79(16 Mar 1974).

Neutron-diffraction study confirmed the occurrence of an UGeTe type of structure in UPTe and UAsTe. The parameters of uranium and X (X = P, As) atoms were refined using the room-temperature neutron data. Below the Curie point, the magnetic moment alignment was found to be along the four-fold axis, in accordance with previous magnetization measurements. The magnetic moment of the uranium ion at liquid helium temperature was determined to be 1.44 and 1.59 μ_B in UPTe and UAsTe, respectively. (auth)

30175 THERMAL CONDUCTIVITY OF ORIENTED FIBROUS CARBON INSULATION FROM 300 TO 1300°K IN NITROGEN AND ARGON AT ONE ATMOSPHERE. Godfrey, T. G. (Oak Ridge National Lab., TN); McElroy, D. L.; Ardary, Z. L. Nucl. Technol.; 22: No. 1, 94-107(Apr 1974).

The thermal conductivity, λ, of three samples of oriented fibrous carbon insulation of possible interest to fusion reactors was measured from 300 to 1300°K in a radial heat-flow apparatus. Samples of 0.18 g/cm^3 density were prepared by a vacuum filtration process from carbon fibers and powdered phenolic resin and were characterized after carbonization. The λ of these low-density composites depended on both the heat treatment temperature and the fiber orientation. For samples heat treated at 1575°K, the room-temperature λ perpendicular to the planes of fibers was ~0.5 mW/(cm °K) and was three times as high in the direction parallel to the planes. At 1000°K, the λ in both directions had doubled, primarily because of the positive $d\lambda/dT$ of the amorphous carbon fibers. Material heat treated at 2775°K had a significantly higher room-temperature λ and a negative $d\lambda/dT$, indicating that a slight degree of ordering or graphitization had occurred in the fibers during heat treatment. At high temperatures, the λ of all three samples increased markedly because of radiative heat transport. (11 figures, 3 tables) (auth)

30176 THERMAL AND ELECTRICAL CONDUCTIVITIES AND SEEBECK COEFFICIENTS OF UNIRRADIATED AND IRRADIATED GRAPHITES FROM 300 TO 1000°K. Moore, J. P.; Graves, R. S.; McElroy, D. L. (Oak Ridge National Lab., TN). Nucl. Technol.; 22: No. 1, 88-93(Apr 1974).

The thermal conductivity λ, electrical resistivity ρ, and absolute Seebeck coefficient S of two grades of nearly isotropic graphite were measured from 300 to 1000°K both before and after neutron irradiation up to 5.0×10^{21} n/cm^2 (>50 keV). Nominal irradiation temperatures were 823, 923, and 1023°K. The thermal resistance, λ^{-1}, of the unirradiated graphites was proportional to T from 500 to 1000°K. Neutron irradiation decreased λ at 300°K by a factor of 4.5 and increased ρ at 300°K by 2.5, in general agreement with previous investigations, and irradiation changed S from small negative values to large positive ones. The product of thermal conductivity and electrical resistivity was nearly constant with fluence from 2.6×10^{21} to 5.0×10^{21} n/cm^2. (7 figures) (auth)

30177 CARBON MATERIALS FOR NUCLEAR REACTORS. Suzuki, H.; Iseki, T. (Tokyo Inst. of Tech.). Zairyo Kagaku; 9: No. 3, 150-157(Jun 1972). (In Japanese).

From the viewpoint of reactor dimensions, light water or heavy water is preferred to graphite as a moderator or a reflector, when temperature of coolant does not exceed 300°C. But there may be no other material than the graphite at some elevated temperature about 1000°C, because of strong refractoriness. Gas-impermeable carbon material was developed to the extent of being applicable to fuel cladding material for high temperature reactors, and an experimental reactor associated with helium coolant has been made, thus future of the high temperature reactors came suddenly to attract attention. Behavior in irradiation at high temperature is quite different from behavior at low temperature. Creep rate increases at high temperature. Reaction of the carbon material with minor impurity in helium should be studied along with impact strength and fatigue due to repeated stress, purity,

and density. The irradiated graphite, according to Reynolds, has relatively small number of such large size defects as 28,000 Å in diameter at 1200°C, while it has innumerable small size defects as 160 Å in diameter at 150°C. Very fine grain graphite POCO AFX-801 shows less dimension change due to irradiation. Electron microscopic pictures of the POCO graphite and EGCR graphite are compared. Nuclear energy is employed in two ways, one for electric power generation, the other for heat supply. For this purpose, HTGRs are very promising systems, in which helium gas is used as coolant. Pyrolytic carbon is used for fuel pellet coating. Future demand for the graphite will be very large, because reactor core materials for the HTGRs must be all ceramics. (JA)

30178 THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIBILITY OF TWO TYPES OF ATJ-S GRAPHITE TO 3500°K. Bapat, S. G. (Southern Research Inst., Birmingham, AL). Carbon; 11: No. 5, 511-514(Oct 1973).

Thermal conductivity and electrical resistivity in the with-grain direction of two types of ATJ-S graphite from 300 up to 3500°K are reported. Above 500°K, the thermal conductivity appears to follow a T^{-1} type function, which is characteristic of umklapp thermal resistivity processes. Results are analyzed in terms of relative first-order contributions of the lattice and electronic components of the thermal conductivity. At high temperatures, the results are at variance with some reported in the literature which indicate a strongly decreasing thermal conductivity or an essentially temperature independent thermal conductivity. (auth)

30179 THERMODYNAMIC PROPERTIES OF CARBON UP TO THE CRITICAL POINT. Leider, H. R.; Krikorian, O. H.; Young, D. A. (Univ. of California, Livermore). Carbon; 11: No. 5, 555-563(Oct 1973).

Thermodynamic data on solid, liquid, and gaseous carbon were carefully selected from the literature or estimated, and vapor pressures were calculated up to the critical point. Certain assumptions about the properties of liquid carbon and nonideal gas corrections for carbon vapor were made. Calculations show the triple point and critical point to be 4765 and 6810°K, respectively, with critical density 0.64 g/cm³, and critical pressure 2200 atm. The dominant vapor species above ~2000°K is C_3, while C_7 is also of importance from 4500 to 6810°K. Coexistence curves which summarize the densities and enthalpies of solid, liquid, and vapor carbon are plotted. The density of liquid carbon is assumed to be 20% less than that of graphite at the triple point. The enthalpy of fusion is given as 30 kcal/g-atom°C. Sublimation enthalpies are found to be 50-66 kcal/g-atom°C at 3000-4765°K, and vaporization enthalpies about 20 kcal/g-atom°C at 4765-6000°K. (auth)

30180 CHANGE OF THE CONDUCTIVITY OF METAL-DIELECTRIC-METAL AND METAL-DIELECTRIC-SEMICONDUCTOR STRUCTURES UNDER THE INFLUENCE OF RADIATION. Patrikeev, L. N.; Podlepetskii, B. I.; Popov, V. D. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 26-33(1973). (In Russian).

Experimental results on the effect of radiation on the conductivity of metal/dielectric/metal (MDM) and metal/dielectric/semiconductor (MDS) structures were reported. A brief theoretical analysis is given of the mechanism of current transmission in dielectric films and in MDS structures. A physical interpretation was suggested by the experimental results. It was shown that the change in conductivity of MDM and MDS structures after irradiation depends on the type of dielectric film and the form of irradiation. (6 figures) (tr-auth)

30181 RADIATION HARDENING OF SILICON. Zotova, L. G.; Khiznichenko, L. P. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 46-48(1973). (In Russian).

The interaction of individual dislocations in Si with defect complexes formed during irradiation with fast neutrons is studied. The dislocations are introduced in samples with known orientations by the method of four-point bend at 600°C. After irradiation with integral fluxes of 5×10^{16}, 10^{17}, and 10^{18} n/cm² the mean free path and tension distributions of the dislocations are measured at 575°C. (tr-auth)

30182 COATING MATERIALS FOR ELECTRIC WIRE. Hakamada, K.; Uda, I.; Nakajima, T. (Sumitomo Electric Industries Ltd., Osaka). Kogyo Zairyo; 21: No. 9, 33-39(Sep 1973). (In Japanese).

The present status of improvement of physical properties by irradiation using electrons to polyethylene and polyvinyl chloride is discussed. Heat resistance is achieved in polyethylene by generating intermolecular cross-linking of the polymer, electron irradiation, and when additives and radiation dose are properly selected, at temperature of 100 to 120°C, the service life of 10,000 to 30,000 hours can be obtained. Environmental stress cracking resistance in polyethylene reaches 1,000 hours by the irradiation of 3 Mrad in the presence of surfactant. Oil-, acid- and alkali-resistance in polyethylene is good. As one example, swelling in 120°C Xylene of the irradiated material at 50 Mrad is 106%. Tensile strength of the irradiated polyethylene at 24 Mrad shows 0.02 kg/mm² at elongation 100%. Inductivity, dielectric loss tangent and volume resistivity of polyethylene are improved by the irradiation. Polyvinyl chloride can be improved so as to have practical physical properties by irradiating a material to which proper cross-linking additives are added. The service life at about 100°C is 100 days, and also tensile strength and wear resistance are remarkably increased. (JA)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

30183 METHODS AND APPARATUS FOR THE NONDESTRUCTIVE ANALYSIS OF NUCLEAR FUELS. Michaelis, W. F. A. (to Gesellschaft fuer Kernforschung mbH). US Patent 3,796,875. 12 Mar 1974. Priority date 25 Aug 1967, F.R. Germany. 8p.

A process and apparatus is described for analyzing a nuclear fuel body by placing such in a channel surrounded by a liquid scintillator with a channel therein in which the body resides, irradiating the body through the channel with low-energy neutrons whereby releasing fast neutrons (n_f) and prompt gamma pulses (γ); measuring the fast neutrons and prompt gamma pulses so emitted by means of detectors and photomultipliers surrounding the irradiated body; and subtracting the n_f, γ coincidences from said gamma pulses, whereby evaluating and analyzing said body. (Official Gazette)

30184 DEVICE FOR NON DESTRUCTIVELY AND SEPARATELY DETERMINING CONCENTRATIONS OF FISSIONABLE MATERIAL IN A TEST SPECIMEN. Krinninger, H.; Wiesner, S. (to Interatom, Internationale Atomreaktorbau GmbH). US Patent 3,796,876. 12 Mar 1974. Priority date 14 Mar 1969, F.R. Germany. 8p.

A device is described for nondestructively and separately determining concentrations of fissionable material in a test specimen. The device consists of a heavy moderator formed of lead having a given slowing-down time and having means for receiving a test specimen, means for irradiating the test specimen with neutrons so as to effect nuclear fissions producing prompt fission neutrons and for producing in the moderator a pulse of monoenergetic fast neutrons of short duration compared to the given slowing-down time of the moderator, and a detector including at least one recoil proton counter for determining, over various time intervals, in accordance with different mean energies of the irradiating neutrons being slowed-down in the moderator, the number of prompt fission neutrons produced in the test specimen. (Official Gazette)

Disposal and Storage

Refer also to abstracts 29178, 29179, 29181, 29182, 29185, 29206, 29277, 29300, 29308–29310, 29336, 29340, 29360, and 29363–29365.

30185 (BNWL-1710) CALCULATION OF SOIL HYDRAULIC CONDUCTIVITY FROM SOIL–WATER RETENTION RELATIONSHIPS. Reisenauer, A. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-2130. 53p. Dep. NTIS $4.00.

A computer program has been written to solve the modified Millington and Quirk equation for computing the hydraulic conductivity curve for partially saturated soil from the moisture retention versus suction measurements. This document describes the equation and computer programs. It also shows plots of test results and compares them with physically measured data. (auth)

30186 (IDO-22053) INFLUENCE OF LIQUID WASTE DISPOSAL ON THE GEOCHEMISTRY OF WATER AT THE NATIONAL REACTOR TESTING STATION, IDAHO: 1952–1970. Robertson, J. B.; Schoen, R.; Barraclough, J. T. (Geological Survey, Idaho Falls, Idaho (USA). Water Resources Div.). Feb 1974. 231p. Dep. NTIS $7.60.

Studies at the National Reactor Testing Station (NRTS), Idaho by the U. S. Geological Survey are described. A summarized evaluation of the geology, hydrology, and water geochemistry of the NRTS and the associated influences of subsurface liquid-waste products discharged from the NRTS facilities are presented. The progressive buildup, distribution, and changes of both radioactive and chemical wastes are analyzed for the total disposal period from 1952 to 1970. Of principal concern is the fate of wastes discharged from the NRTS in the Snake River Plain aquifer, an extremely large and productive groundwater system underlying the vast eastern Snake River Plain. Since 1952, the NRTS facilities (primarily the Test Reactors Area—TRA, Idaho Chemical Processing Plant—ICPP, and the Naval Reactor Facility—NRF) have discharged 1.6×10^{10} gallons of liquid waste containing 7×10^4 curies of radioactivity and about 1×10^8 pounds of chemicals to the subsurface. The discharge has been disposed in wells and seepage ponds. The principal waste products include tritiated water, ^{90}Sr, ^{137}Cs, ^{60}Co, sodium chloride, chromates, and heat. Wastes at the NRTS have been distributed in the Snake River Plain aquifer and overlying bodies of perched groundwater according to hydrologic and geochemical controls. Expansion of the plume of waste products in the aquifer from the ICPP disposal well has been traced over the years. Chloride and tritium in this plume are most widely distributed, detectable over about 15 miles of the aquifer. Migration of cationic waste products, especially ^{90}Sr and ^{137}Cs, has been greatly retarded by sorption. Radioactive decay is a significant influence on the spreading and dilution of wastes as they move down-gradient in the aquifer. No detectable wastes have been found close to or beyond the southern boundary of the NRTS. Materials and heat balances calculated for the ICPP wastes indicate that the interpretive subsurface distributions are valid and that the wastes generally remain in the upper 250 ft of the aquifer. The balances indicate that heat and tritium are maintaining an equilibrium (nearly constant) inventory. Waste plumes from TRA and NRF are poorly defined because of insufficient observation wells. (auth)

30187 (INIS-mf-936, pp 3-7) RESEARCH AND DEVELOPMENT WORK IN WASTE MANAGEMENT. Dlouhy, Z. May 1973.

A review is presented of the research into waste management in Czechoslovakia that is mainly concentrated on: (a) decontamination of liquid wastes, including sorption on inorganic sorbents, synthesis of bivalent metal sulfates capable of selective extraction of radiostrontium and radium from highly concentrated solutions containing ballast salts, study in the kinetics and mechanism of Sr sorption, study in the separation of long-lived usable nuclides, development of precipitation, coprecipitation and ion exchange methods and of radiocolloid sorption on hydrated oxides; (b) disposal of gaseous radioactive wastes; (c) solidification of radioactive wastes, including the development of vacuum concentration techniques and the construction of waste bitumination units, and basic research into vitrification and incorporation of highly active wastes into basalt; and (d) storage of radioactive wastes, including the analysis of requirements for the stability and other properties of solidified products and of the criteria for the selection of suitable storage sites. (INIS)

30188 (INIS-mf-936, pp 53-60) LONG-TERM STORAGE OF RADIOACTIVE WASTES. Dlouhy, Z.; Safar, O. May 1973.

Problems of long-term storage of radioactive wastes are analyzed in relation to the place of origin of the wastes, namely in view of the siting of nuclear power stations and of spent fuel reprocessing plants. The criteria for the choice of a suitable locality for the siting of plants as well as of radioactive waste dumps that should be taken into account are: geological, hydrogeological, and hydrological situations of the locality, climatic conditions, protective zones, transport conditions, operating conditions of the respective plant, and economic aspects. In addition, criteria for the exclusion of certain localities exist that should be respected. (INIS)

30189 (ORNL-TM-4370, pp 315-358) RADIOACTIVE WASTE DISPOSAL. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

Supportive experimental investigations were conducted relative to three different methods of radioactive waste disposal: (1) salt-mine repositories for high-level solid wastes, (2) shale fracturing process for intermediate-level waste solutions, (3) and pressurized aqueous combustion (PAC) for ashing combustible wastes. (LK)

30190 (WASH-1297) HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT ALTERNATIVES. (USAEC Division of Waste Management and Transportation, Washington, D. C.). May 1974. 94p. Dep. NTIS $5.45.

A summary of a comprehensive overview study of potential alternatives for long-term management of high-level radioactive waste is presented. The concepts studied included disposal in geologic formations, disposal in seabeds, disposal in ice caps, disposal into space, and elimination by transmutation. (TFD)

30191 GENERAL PRINCIPLES ON THE REGULATIONS CONCERNING THE DISPOSAL OF LIQUID GASEOUS AND SOLID RADIOACTIVE WASTES. Cantillon, G. E. (Ministere de la Santa Publique et de la Famille, Brussels). J. Belge Radiol.; 56: No. 5, 435–438(1973). (In French).

The purpose of this talk is to introduce the next papers that will be devoted to the treatment and disposal of radioactive waste from different sources: nuclear industry, hospitals, laboratories, etc. The fundamental rules edicted by international radiation protection organizations are discussed. The way those recommendations are

applied to liquid, solid, and gaseous effluents, in the Belgian legislation, is described. (auth)

30192 END TASK TO BE UNDERTAKEN IN NUCLEAR POWER DEVELOPMENT. Approach to Utilization and Disposal of Nuclear Fission Products. Kimura, K. (Tokyo Univ.). At. Jap.; 17: No. 6, Suppl., 73-81(Jun 1973).

From sixth annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

With the advance of nuclear power generation, the quantity of high-level radioactive wastes which contain fission products (FP) and transuranium elements (TU) increases. These radioactive wastes must be treated comprehensively and systematically. To study the problem, a council was organized in the JAIF, with three working groups to examine the utilization techniques of FP and TU, disposal methods, and the deactivation of radioactivity, respectively. The utilization and disposal of the high-level radioactive wastes are described. In the utilization techniques, the total systems for FP and TU are reviewed. Since fuel reprocessing is carried out mostly by the wet chemical method, the wastes consist of highly active liquids and gases. Finally, in order to cope with the problem conclusively, change of radionuclides into stable or short-lived ones, or their deactivation, is essential. (JA)

30193 CONTROL OF LOW-LEVEL LIQUID RADIOACTIVE WASTE DISPOSAL: UK EXPERIENCE IN THE DERIVATION AND USE OF ENVIRONMENTAL CAPACITY. Mitchell, N. T.; Jefferies, D. F. (Ministry of Agriculture, Fisheries, and Food, Lowestoft, Eng.). pp 633-647 of Environmental Behavior of Radionuclides Released in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973). See STI/PUB-345; CONF-730503-.

UK policy on the control of radioactive waste depends primarily on limiting public radiation exposure as this has been found to be more restrictive than potential damage to environmental resources. Assessments of environmental capacity are thus of paramount importance and have become a central feature of the critical pathway approach as practiced in the UK. For this purpose environmental capacity is usually identified as a rate of input of radioactivity of specified isotopic composition that, under equilibrium conditions, would result in an exposure of the public equal to the ICRP-recommended dose-limits. How assessment of environmental capacity is conducted is described and involves detailed studies of the behavior of radioactivity after release to the environment and the pathways which lead to public radiation exposure. Each assessment is valid only in relation to the appropriate food consumption rate or other habits of the exposed population resulting in exposure. Each pathway can be visualized as involving several stages such as dilution, dispersion, reconcentration, and public use of the environment, culminating in radiation exposure. Each of these stages is discussed to show the factors that must be considered. The procedures adopted in the UK for the evaluation of environmental capacity are discussed in the context of disposal of liquid radioactive wastes to freshwater lake and river systems, particular reference being made to the nuclear power station site at Trawsfynydd and the supporting radioecological research conducted there. Recent experience in re-assessment of environmental capacity in relation to changing factors, such as effluent composition, is discussed and the paper concludes with an account in terms of public radiation exposure of how application of a control policy dependent on the assessment of environmental capacity has ensured the continued safety of waste disposal and the maintenance of very high standards of environmental protection. (auth)

30194 IMPROVED CONTROL OF RADIOACTIVE WASTES. Stubblefield, F. E. (Atomic Energy Commission, Bethesda, MD); Jackson, E. B. Chem. Eng. Progr.; 70: No. 3, 87-88(Mar 1974).

New and improved methods for the underground storage of liquid and solid wastes at the Hanford Plant are discussed. The burial of solid wastes involves several steps of waste segregation, volume reduction, packaging in retrievable containers, and enclosure in covered concrete V-trenches. The handling of liquid radioactive wastes is described. Information is included on waste processing for radioisotope removal, waste solidification and encapsulation, liquid waste storage in underground tanks, and the monitoring of waste storage facilities. (LCL)

Handling Equipment and Procedures

Refer also to abstracts 29279, 29650, 29768, 29783, and 31273.

30195 PREDICTION OF FAST NEUTRON SPECTRA IN CRITICALITY ACCIDENTS. Cross, W. G.; Ing, H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 73-86 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

Since personal neutron dosimeters yield very little information on fast neutron spectra, the determination of fast neutron dose received in criticality accidents requires assumptions about the spectrum. The accuracy of these assumptions is particularly important when a significant fraction of the dose comes from neutrons with energies below the lowest threshold of the detectors used. Some simple spectral models for interpreting dosimeter readings for excursions involving bare critical assemblies and assemblies moderated by light elements are proposed. For systems containing only heavy elements, the proposed spectral shape is given by the sum of a Maxwellian fission spectrum and an evaporation term describing the spectrum of inelastically scattered neutrons. The relative intensities of the two components depends on the macroscopic cross-sections for fission and inelastic scattering and on $\bar{\nu}$, but is independent of the shape and dimensions of the system. For systems moderated by light elements, the escape spectrum is assumed to be the "equilibrium" spectrum in an infinitely large system with uniformly distributed fission sources. These model spectra have been compared with spectra measured or computed for about a dozen existing critical assemblies. The agreement is within about 15%. To provide additional data with which to compare our models, Monte Carlo calculations were used to study how escape spectra change with assembly dimensions, with passage through thin layers of light moderators and with backscattering. These calculations show, among other things, what moderator dimensions are required to build up the assumed "equilibrium" spectra. The doses that would be derived from typical threshold detector measurements, using both the "true" spectrum and the above models for relating activities to dose, were calculated for various critical systems. For a $^{103}Rh(n,n')$ ^{103m}Rh detector, use of the model spectra resulted in a dose error that was always less than 15%. In general, we find that spectra can be predicted for a wide variety of critical assemblies with sufficient accuracy for personal dose determination merely from knowledge of the amounts of fissile and moderating elements present and without making detailed computer calculations for each assembly. (auth)

30196 DIFFERENT TYPE GLOVE BOX FILTERS USED FOR ^{238}Pu WORK. Angel, K. C.; Anderson, H. F. (Monsanto Research Corp., Miamisburg, OH). Contract AT-33-1-GEN-53. pp 981-993 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

A review is presented of the different type glove box filters that have been used with ^{238}Pu glove boxes at Mound Laboratory. Three filter installation types are discussed: (1) box-type filter mounted inside a small housing on top of glove box, (2) cylindrical filter with 2-in. diameter threaded pipe at one end designed to screw into exhaust line inside glove box, and (3) dual cylindrical filters with molded rubber gaskets designed to fit inside a stainless steel or fiberglass tube below the glove box. Each type filter installation is discussed in terms of filtration adequacy, sources of leaks, ease of filter change, contamination control problems during filter change, and interference with glove box operations. (auth)

30197 HEALTH PHYSICS AT THE LOS ALAMOS WING 9 HOT-CELL FACILITY. Valentine, A.; Fitzgibbon, F.; Martinez, L. (Los Alamos Scientific Lab., NM). pp 141-164 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Health physics programs at the Los Alamos "Wing 9" hot cell facility are described. The 16-cell facility is used primarily for testing and examination of irradiated reactor fuel, but it is also the main LASL facility for materials irradiation, large source handling, and other miscellaneous hot-cell work. Eight cells are equipped with sealed alpha containment boxes for safe handling of plutonium enriched fuels. Control systems and operating practices that affect health physics at the facility are discussed as well as health physics programs such as area monitoring, personnel dosimetry, air monitoring, surface monitoring, and monitoring instrumentation. (auth)

30198 HEALTH PHYSICS ASPECTS OF TRITIUM CONTROL AT THE LAWRENCE RADIATION LABORATORY, LIVERMORE.

Silver, W. J.; Chew, M. H. (Univ. of California, Livermore). pp 265-284 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The health physics aspects of operations conducted in the LRL Livermore facility for handling multikilo curie quantities of tritium are reviewed. The 21,000 ft^2 laboratory is used primarily for experimental and developmental work with tritium and its compounds. Techniques for material and exposure control that are shown include containment, ventilation, continuous air and stack monitoring, personnel training, bioassay, and environmental sampling. Also presented is an analysis of absorbed-dose data gathered during the seven years of facility operation. Emergency response plans for accidents involving tritium releases are discussed. A method is given for quickly estimating the downwind dose following an accidental release of tritium. A unique technique has been developed and used for replacing a highly contaminated enclosure window. (auth)

30199 RADIATION CONTROL PROGRAM AT THE DONALD W. DOUGLAS LABORATORIES. Smith, M. L. (Douglas Labs., Richland, WA). pp 311-320 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The McDonnell Douglas Astronautics Company built and operates the Donald W. Douglas Laboratories at Richland, Washington. The 57,600 ft^2 facility is located on a 112 acre site. One wing of this multipurpose laboratory houses a radioisotope laboratory and a composite fuels laboratory. The problem of two years of operation of the hot laboratory and fuels research laboratory is discussed. To limit the accident potential, a radioactive storage building is utilized. Materials are stored in sealed containers. The procedural control of the inventory is illustrated. Disposal of high specific activity waste has posed some unique problems. Single swabs can contain more than 100 curies. An agreement with the State of Washington licensing agency and the waste disposal company permits shipment of waste. Radiation dosimetry for ^{147}Pm and its associated 66 KeV gamma has been difficult. The angular dependence of the film dosimeter is shown where there is a distributed source causing an error of a factor 3 in the dosimetry. The solution to this problem is shown. (auth)

30200 MONITORING DURING PLUTONIUM SALT TRANSPORT SEPARATION EXPERIMENTS PERFORMED IN A WALK-IN HOOD. Lissy, A. E. (Argonne National Lab., IL). pp 339-348 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

High-temperature experiments of about five days duration involving from 20 to 200 grams of plutonium plus kilograms of molten salts and metals were conducted in furnaces located in a walk-in hood. Alpha surveys were performed with two types of alpha gas pacs and air samples. The furnaces were prepared, loaded, and sampled. Additional salts and metals were charged to furnaces during the experiments. Molten metal and salt were transferred between the two furnaces by heated transfer tubes. Thermally hot samples were taken, cooled with Freon and double bagged, prior to removal from the hood. After the furnaces cooled overnight, they were manually unloaded. Only rarely was alpha contamination found on bagged out components. When in the hood, the experimenters worked very carefully changing gloves frequently and wiping up regularly in performing the various operations. This and frequent surveys kept the contamination to a minimum. Protective clothing (paper coveralls) and supplied air masks were utilized. Contamination on the coveralls ranged to 20,000 disintegrations per minute per 61 square centimeters, and this was found primarily on the sleeves. The paper coveralls were carefully removed at the doorway of the walk-in hood and disposed of as waste. All air samples were negative. (auth)

30201 HEALTH PHYSICS ASPECTS OF WORKING WITH $^{238}PuO_2$ MICROSPHERES. Edling, D. A.; Musen, L. G.; Deel, B. L. (Monsanto Research Corp., Miamisburg, OH). AT-33-1-GEN-53. pp 449-470 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Some of the health physics problems are discussed. Both general and specific problems associated with $^{238}PuO_2$ microsphere work and necessary health physics preparations and operating techniques used during such work are discussed, e.g., decontaminating production batches of microspheres, photographing of microspheres after decontamination, alpha counting of microspheres in a low risk area, weighing of microspheres in a low risk area, and metallographic examination of microspheres, etc. (auth)

30202 DIFFERENCES IN APPLIED HEALTH PHYSICS PROBLEMS AND PROCEDURES BETWEEN ^{238}Pu AND ^{239}Pu. Edling, D. A.; Anderson, H. F. (Monsanto Research Corp., Miamisburg, OH). AT-31-1-GEN-53. pp 471-486 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The major differences in applied health physics problems and procedures for work with ^{238}Pu and ^{239}Pu are compared. This comparison is based on 10 y experience with both isotopes at Mound Laboratory. Dose rates external to ^{239}Pu glove boxes are higher than for ^{238}Pu glove boxes and, in general, a more frequent dose rate surveillance program is required in ^{238}Pu work areas. Greater health physics support for glove box maintenance operations is required in ^{238}Pu work areas because the gloves and viewing windows deteriorate faster and must be changed more frequently than in ^{239}Pu work areas. Contamination control procedures are more strict in ^{239}Pu work areas than in ^{239}Pu work areas. The differences in contamination control procedures for pass out operations, glove changes, viewing window changes, and maintenance on vacuum lines out of gloveboxes are discussed. (auth)

30203 EXTERNAL RADIATION PROBLEMS IN THE MANUFACTURE OF HIGH BURN-UP PLUTONIUM FUEL ELEMENTS IN GLOVE BOXES. Potter, T.; Caldwell, R. (Nuclear Materials and Equipment Corp., Apollo, PA). pp 487-504 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The manufacture of high burnup plutonium fuel elements in glove boxes raises new problems in determination and control of external exposure. NUMEC's experience in manufacturing Pu-U-Mo (28.4%) ZPPR fuel elements is described. The plutonium contained 11.5% ^{240}Pu and 1.6% ^{241}Pu. Only complete characterization of the radiation, complete evaluation of dose, and prompt implementation of control measures prevented overexposure of a large work force. Data presented include characterization of gamma and neutron radiation sources, gamma and neutron spectra from exposure locations and different fuel materials, shielding evaluation, comparison of LiF TLD and film for gamma exposure measurement, evaluation of the deficiencies of NTA film for neutron exposure measurement, and studies of dose inhomogeneity. (auth)

30204 PERSONNEL DOSIMETRY ASSOCIATED WITH THE HANDLING OF LARGE NUMBERS OF 3-kg ^{238}Pu BILLETS. Myers, D. S.; Prevo, C. T. (Univ. of California, Livermore). pp 505-517 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The current operations of the Lawrence Radiation Laboratory, Livermore, critical array study group involve the handling of up to 128 plutonium billets. Each of the billets contains approximately 3 kilograms of ^{238}Pu (including small quantities of other plutonium isotopes) clad in aluminum and stainless steel. When the billets are handled individually, they present a hand dose problem; however, when they are in sizable arrays, the whole-body dose becomes the controlling factor. Although ^{240}Pu is present only in small quantities, its relatively short spontaneous fission half-life produces a significant neutron flux (approximately 5×10^5 neutrons/sec per billet). The neutron film (Kodak type NTA) proved quite unsatisfactory for measuring whole-body neutron doses in these studies; thus the technique used to establish the whole-body neutron dose rate was to measure the neutron-to-gamma dose rate ratio for the array environment radiation using a variety of gamma and neutron detectors. Since the neutron-to-gamma dose rate ratio is dependent upon the size, spacing, and moderation of the array, a new ratio is determined for each array. A neutron-to-gamma dose rate ratio was also established for billet surface radiation using computer techniques.

The neutron dose is then established by applying the measured neutron-to-gamma ratio to the whole-body gamma dose as measured by the film badge, and to the gamma hand dose as measured by thermoluminescent dosimeters. (auth)

30205 RADIATION PROTECTION ASPECTS OF WORK WITH POLONIUM-210. Howell, W. P. (Battelle Pacific Northwest Labs., Richland, WA). pp 539-559 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The radiation protection problems encountered during preparation and encapsulation of rare earth polonide compounds in kilocurie quantities are described. The high specific activity of ^{210}Po and its tendency to vaporize at relatively low temperatures make contamination control the most significant problem. Control of external dose is also required due to the relatively hard gammas (0.8 MeV) accompanying a small fraction of the alpha disintegrations, and fast neutrons resulting from -n reactions. Particularly difficult health physics problems are presented due to migration of polonium particles through standard enclosure gloves and absolute filters. The related problem of the high temperature of concentrated sources is also discussed. (auth)

30206 RADIOLOGICAL EMERGENCY EXPERIENCE IN AN INDUSTRIAL PLUTONIUM PLANT. Caldwell, R.; Potter, T.; Schnell, E. (Nuclear Materials and Equipment Corp., Apollo, PA). pp 1581-1599 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From 3rd Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Four separate radiation accidents at NUMEC's Plutonium Plant are described. Two involved exploding glove boxes, one was a hand amputation in a plutonium milling machine box and the fourth was an uncontrolled release of ^{192}Ir aerosol from a shielded hot cell. Each incident presented unique radiation monitoring problems and the experiences led to a revision of emergency plans. Handling of exposed and injured individuals, and recovery techniques are also discussed. (auth)

30207 IMPROVEMENTS IN OR RELATING TO REMOTE HANDLING DEVICES. Curtis, W. K. (to United Kingdom Atomic Energy Authority). British Patent 1,341,489. 19 Dec 1973. Filed date 20 Sep 1973. 15p.

Reference is made to remote controlled manipulators of the type known as "master slave manipulators". Difficulty has sometimes been encountered in removing a damaged slave assembly from the remainder of the manipulator, and conventional techniques employ a crane or hoist located in the "hostile" environment to support the slave arm while it is disassembled. The whole operation may be a lengthy job, with the personnel involved subjected to long periods in the "hostile" environment. In the arrangement described an integral coupling and decoupling mechanism is provided for effecting movement of the slave assembly from a first position where it is connected to, and supported by, the remainder of the manipulator assembly, to a second position where it may be separated from the remainder of the assembly, and vice versa. A winching mechanism may be provided for raising the slave assembly to, or lowering it from, the second position; details are given of alternative constructions of this winching mechanism. (UK)

Transportation

Refer also to abstract 29783.

30208 (RFP-1867(Rev.1)) ROCKY FLATS MODEL 2030-1 CONTAINER (AEC-AL US/A/5332/BLF) SAFETY ANALYSIS REPORT FOR PACKAGING (SARP). Adcock, F. E.; McCarthy, J. D.; Wackler, W. F. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 27 Feb 1974. Contract AT(29-1)-1106. 26p. Dep. NTIS $4.00.

The Model 2030-1 Container is used by Rocky Flats Division, Dow Chemical U.S.A., for shipping unirradiated fissile material in solid form. Components consist of a 30-gal steel drum, Celotex insulation, and stainless steel containment vessel(s) of 10-in. dia. A simple venting system prevents rupture of the outer drum in the event of accidental fire. Approved material limits include 5 kg of plutonium or 11 kg of enriched uranium. Thermal decay energy is normally limited to 20 W. Results of extensive tests show the container will function effectively when exposed to all environment and accident conditions as required. The containment vessel temperature rise will not exceed 140°F during the thermal test. Internal heating of 20 W will cause an additional temperature rise of 80°F. (auth)

30209 (TID-26551) ENGINEERING ANALYSIS REPORT OF THE DESIGN OF THE F-144-1 SHIPPING CONTAINER TO E. I. DU PONT DE NEMOURS AND COMPANY. Lusk, E. C.; Burian, R. J. (Battelle Columbus Labs., Ohio (USA)). 22 Sep 1972. 52p. Dep. NTIS $5.75.

Design and engineering parameters for the F-144-1 shipping container for transporting FFTF fuel pin bundles or fuel assemblies are presented. (TFD)

30210 ALTERATION OF THE ANNOUNCEMENT (1958: 652) WITH RULES ON APPLICATION OF THE RADIATION PROTECTION LAW. Sv. Forfattningssamling; No. 38, vp(12 Feb 1974). (In Swedish).

The law is an alteration of rules on application of the radiation protection law (1958: 652). It concerns international transport of radioactive substances on roads. (SW)

30211 AERIAL DETECTION AND RECOVERY OF A COBALT-60 SOURCE LOST IN INTERSTATE SHIPMENT. Eskridge, H. E.; Hand, J. E. (EG and G, Inc., Las Vegas, NV). pp 1481-1487 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

A twin-engine aircraft routinely used for aerial radiation surveys was successfully employed to rapidly locate a 325-millicurie cobalt-60 source lost in transit between Salt Lake City, Utah, and Kansas City, Missouri. The route followed by the carrier, a distance of approximately 1100 road miles, was plotted on appropriate flight maps and a crew of three departed from Las Vegas, Nevada, to begin the search at Salt Lake City. Upon arrival over the starting area the aircraft descended to an altitude of 400 ft and began data collections along the route taken by the transport vehicle. A sharp count rate peak indicative of a point source was encountered soon after crossing the Missouri River at St. Joseph, Missouri. Spectral data confirmed that the high count rate was due to cobalt-60. Additional passes were made to better define the location and the crew then landed and recovered the source. Instrumentation and detection capabilities of the aircraft systems are described. Advantages of using aerial monitoring for other types of accident and emergency monitoring situations are also discussed. (auth)

30212 IMPACT OF THE TRANSPORTATION REGULATIONS ON THE ROLE OF THE HEALTH PHYSICIST. Grella, A. W. (Dept. of Transportation, Washington, DC). pp 1717-1741 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

The role of the health physicist in relation to packaging and transportation of radioactive materials is discussed. The important bases of the United States and International regulations, which relate to health physics concepts are elaborated. An emphasis is made on the importance of the operating health physicist being well informed of the availability, applicability, and interpretation of the transportation regulations, especially in view of his frequent role as a consultant to other groups, such as the engineering and traffic functions, on such matters. A review is also made of the sources and applicability of the current regulations for packaging and transportation of radioactive materials, including the recent revisions to the U. S. Department of Transportation regulations. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 29515, 29768, 29778, and 30771.

30213 (AECL-4512) UPGRADING OF THE CRNL MP TANDEM FOR 13 MV OPERATION. Burn, N.; McDonald, A. B.; Andrews, H. R.; Milton, J. C. D.; Bender, L. B.; Brown, P. W. A.; Imahori, Y.; O'Dacre, J. P. D.; Sharp, F. J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1973. 45p. Dep. NTIS (U. S. Sales Only) $5.25. AECL $1.50.

The Chalk River MP Tandem accelerator has been upgraded from 10 MV to 13 MV operation by the installation of new resistors and a set of high-gradient stainless-steel electrode accelerating tubes, manufactured by High Voltage Engineering Corporation. Without tubes, the column structure of the accelerator was tested at voltages up to 16 MV using SF_6 at 90 psig (0.71 MN/m^2) as insulating gas. The most important requirement for this high voltage operation was the elimination of dust and larger fragments of the belt falling from the column; the insulating gas pressure was not critical. Oxygen appeared unsuitable as a stripper gas, to be pumped irreversibly by the new tubes and to result in unstable operation. Nitrogen gas is a satisfactory substitute. The transmission of the new tubes is 40 to 50% for protons and oxygen from a low emittance direct extraction duoplasmatron or from a Heinicke-Penning source. Operation at 13 MV for long periods has been achieved for a variety of ions with as few as two voltage breakdowns per 24 hours. Conditioning and operating procedures are described. (auth)

30214 (RL-74-28) NIMROD OPERATION AND DEVELOPMENT QUARTERLY REPORT OCTOBER 1 TO DECEMBER 31, 1973. Gray, D. E. (ed.). (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Feb 1974. 20p. Dep. NTIS (U. S. Sales Only) $4.00.

The Nimrod beam was on for High Energy Physics Research for 85% of HEP scheduled operating time. One experiment commenced, three continued through, and four were completed in the period. A description of Nimrod's second rf system is given. Operation of the 1.5 meter cryogenic bubble chamber in 1973 is reviewed. (auth)

30215 PARTICLE ACCELERATOR WITH MEANS FOR OPTIMIZING THE UTILIZATION OF THE BEAM POWER THEREOF. Dorschner, H.; Heger, A. (to VEB Textilkombinat Cottbus). British Patent 1,340,215. 12 Dec 1973. Filed date 24 Jun 1971. 7p.

Reference is made to particle accelerators working on the alternating current principle, and particularly to electron accelerators for use in radiation chemical processes. Such accelerators allow pulsing of the beam. Some disadvantages of earlier accelerators of this type are stated, the main problem being suppression of natural spreading of the beam occurring transversely to the direction of movement of the material being irradiated. In the system described means are provided inside and/or outside the accelerator for establishing homogeneous and/or non-homogeneous electric and/or magnetic fields in such a manner as to return, to the desired beam utilization area, radiation scattered transverse to the direction of movement of the target material. (UK)

30216 BONNER SPHERES AND TISSUE-EQUIVALENT CHAMBERS FOR EXTENSIVE RADIATION AREA MONITORING AROUND A ½-TeV PROTON SYNCHROTRON. Awschalom, M. (National Accelerator Lab., Batavia, IL). pp 297-313 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The National Accelerator Laboratory houses a proton synchrotron designed to accelerate 1.5×10^{13} protons/s to 200 GeV. On July 16, 1972, operations at 300 GeV were achieved. 400 GeV are expected soon. The injector for this synchrotron consists of a 750-keV Cockcroft-Walton, a 200-MeV linac and an 8-GeV synchrotron. The length of the accelerators and the experimental areas is about 11 km. The problem of providing real time radiation area monitoring has been mostly solved by using polyethylene pseudospherical moderators with a thermal neutron detector in the center (modified Bonner spheres) and tissue-equivalent ionization chambers whose output is collected by a low cost, very high reliability multiplexing system. A brief description of the multiplexing system is given. This system uses two pulse-height analyzers (PHA) appropriately modified. One is used for data storage and the other as a digital dose-rate meter. Only three twisted conductor pairs are used to connect all the detectors to the central data logger. To reduce the cost of machining the Bonner spheres, two other shapes were investigated. From this study, "pseudospheres" (octagons of revolution) were adopted for the moderators. The Laboratory Director has ordered that the accelerator-produced radiation exiting the site boundaries should not exceed ten (10) millirem/year. To measure these additional low doses to the environmental radiation, a mobile environmental radiation monitoring laboratory is being built. Correlation techniques with radiotelemetering will be used to measure neutron and gamma fluxes. In the fixed environmental radiation monitoring laboratory, a novel technique is used to enhance the signal-to-noise ratio of the ^{6}LiI(Eu) crystals used in an extended Bonner spectrometer. (auth)

30217 NEUTRON DOSIMETRY AT HIGH-ENERGY PARTICLE ACCELERATORS. Thomas, R. H. (Univ. of California, Berkeley). pp 327-353 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

Nowhere are the neutron dosimetry problems greater for the health physicist than at accelerator installations. Here the neutrons are produced over a wide range of energies, accompanied by other particles (most frequently photons) and often with inconvenient duty cycles. Under these conditions, many of the techniques of measurement used in conventional health physics are of less value than techniques directed toward an understanding of the radiation environment in physical terms. In many accelerator laboratories, therefore, considerable efforts have been made to develop techniques of neutron spectrum determination. At the Lawrence Berkeley Laboratory, a comprehensive system of activation detectors has been developed, capable of covering the energy range of interest. These activation techniques are supported by measurements with nuclear emulsions, fission chambers, and a polyethylene-lined proportional counter when appropriate. Over the past five years, unfolding routines have been established which are capable of yielding neutron spectra with accuracy certainly good enough for radiation protection purposes. During this period, too, our understanding of the interpretation of such spectra in terms of dose-equivalent has greatly improved, so that reliable estimates of DE are possible. These techniques are fully described and discussed. (70 references) (auth)

30218 PULSED α-BEAM WITH THE ERLANGEN TANDEM ACCELERATOR. Frosch, D.; Lampert, W.; Phillipp, G.; Scheib, U. (Univ., Erlangen, Ger.). Nucl. Instrum. Methods; 116: No. 2, 267(1974).

The properties of a pulsed α-beam at the Erlangen tandem accelerator were studied using a modified HVEC $^4He^-$ ion source. (WHK)

30219 PULSED MODE OF THE KLYSTRON-ACCELERATOR SECTION. Antipov, K. I.; Mufel, V. B. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 18: No. 2, 306-308(Feb 1973).

Translated from Radiotekh. Elektron.; 18: No. 2, 420-422(Feb 1973).

A method for matching the sections of electron linear accelerators in the pulse mode is discussed. (WHK)

30220 LINEAR INDUCTION ACCELERATOR: NEW GENERATORS OF POWERFUL BEAMS OF RELATIVISTIC ELECTRONS. Vakhrushin, Yu. P.; Matora, I. M. (Scientific Research Inst. of Electrophysical Apparatus, Leningrad). Usp. Fiz. Nauk; 110: No. 1, 117-137(May 1973). (In Russian).

Operation of the first operative linear induction accelerator showed that the method on which this accelerator is based makes it possible to obtain at efficiencies in tens of percent relativistic electron beams in hundreds and thousands of amperes reliably and repeatably. Intense development of accelerators of this type was carried out in a series of laboratories. Its theory and methods of calculation were developed. The results of works published in this area are systematized and discussed. The theory of linear induction accelerators, the form of the accelerating field, and the confinement of the high-current beam are examined. The parameters of both the operative and under-construction accelerators are reported and the construction of the basic subassemblies are briefly described. (tr-auth)

30221 MOTION OF PARTICLES IN LASER BEAMS. Askar'yan, G. A. Usp. Fiz. Nauk; 110: No. 1, 115-116(May 1973). (In Russian).

The forces acting on particles in a laser beam for coherent acceleration are defined. These include the gradient force, the force of light pressure, and forces connected with the absorption of light. (JSR)

30222 EFFICIENT ELECTRON ACCELERATORS FOR INDUSTRIAL RADIATION PROCESSES. Freiberg, E.; Gleyvod, R.; Reinhold, G. (Haefely (Emil) und Cie AG, Basel). Neue Tech.; 15: No. 8, 310-315(Aug 1973). (In German).

Industrial electron accelerators have reached a high reliability and performance state which are characterized by a beam power of 50 to 100 kW and accelerating voltages up to 4 MV. They are used for industrial radiation processes which require a high production capacity, such as paint curing. (auth)

30223 181-TUNGSTEN CONTAMINATION INCIDENT. Busick, D.; Warren, G. (Stanford Univ., CA). pp 1281-1289 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

A contamination incident at SLAC occurred in the accelerator housing at the positron source, due to a cooling water spill. This incident principally involved ^{181}W. From 5 to 50 μCi of ^{181}W was found on hands and clothing of several workers. The relative insolubility of tungsten resulted in contamination about three orders of magnitude greater than predicted from routine water sampling. A brief description of the incident, methods of detection, and the relative importance of this occurrence are discussed. (auth)

30224 HEALTH PHYSICS PROGRAMS AT LOW ENERGY PARTICLE ACCELERATOR FACILITIES. Boggs, R. F. (Bureau of Radiological Health, Rockville, MD); Gundaker, W. E.; Brobeck, W. M.; Altes, R. G. pp 67-88 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The number of particle accelerators in use in medicine, industry, and research is increasing due to the rapid development of new applications for these machines and to their increasing commercial availability. While the major national laboratories and large research facilities have adequately trained personnel and proper health physics equipment, many facilities which utilize the smaller and lower energy accelerators do not have the resources to develop such sophisticated health physics programs. In recognition of this problem, the Public Health Service contracted with William M. Brobeck and Associates to study and develop a Particle Accelerator Safety Manual applicable to the lower energy machines to alert personnel to the various hazards, survey techniques, and recommended safety procedures for each of the major types of particle accelerators. Results of this investigation are presented including (1) a description of each type of particle accelerator—what they are, what they do, and what they can be used for; (2) basic operation procedures; (3) instrumentation needed to detect and measure the types of radiation present; (4) typical shielding required for the appropriate radiations and energies; and (5) safety interlocks and warning systems. (auth)

30225 HIGH INTENSITY ELECTRON ACCELERATOR RADIATION HAZARDS. Parker, J. R.; Engelke, M. J. (Los Alamos Scientific Lab., NM). pp 179-199 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

A 30 MeV, 1 mA, average current, linear electron accelerator was built at Los Alamos to serve as a prototype for development work being done on the Los Alamos Meson Physics Facility. As this accelerator was to have a much higher intensity than ever achieved before, an extensive study of possible radiation hazards was made prior to operation. A review of that study is given. The three kinds of radiation, bremsstrahlung, neutrons, and residual, encountered in the operation of electron accelerators, are reviewed. Theoretical and empirical bases for estimating these are demonstrated for a 30 MeV accelerator. The values obtained are compared with experimental values. Calculations for air activation and required ventilation are also presented. Shielding penetration measurements are also presented. (auth)

30226 HEALTH PHYSICS AT THE ARGONNE 12.5 GeV ZERO GRADIENT SYNCHROTRON. Howe, H. J. Jr.; Jascewsky, E. J.; Mundis, R. L. (Argonne National Lab., IL). pp 201-226 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The operational Health Physics program employed at the Argonne 12.5 GeV Zero Gradient Synchrotron (ANL-ZGS) is summarized. Measurement techniques, radiation areas and methods of protection, personnel and area monitoring methods and results, interlock systems, etc., are described. Descriptions of the time and spatial distributions of the induced radioactivity as well as the mixed neutron-gamma radiation fields are given. Emphasis is placed on typical results gained during the past two years of operation. (auth)

30227 OPERATIONAL MONITORING AT THE PRINCETON–PENNSYLVANIA ACCELERATOR. Schimmerling, W.; Awschalom, M. (Princeton Univ., NJ). pp 227-264 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The results of surveys for the main radiation areas are presented. Dose rates in the external beam hall have been 1 to 3 mrem/hr, almost entirely due to neutrons. The top of the external beam shielding has constituted a virtual radiation source. This made additional shielding necessary to protect a lunch room adjacent to the building. Remanent radioactivity results are presented. Finally, a device for establishing occupancy times automatically is described. The results of area surveillance are used to establish personnel doses wherever possible. A formula to establish occupancy times in mixed radiation fields is discussed. Pocket dosimeters are shown to be more convenient and economical than thermoluminescent dosimeters for day-to-day monitoring. The only significant transferrable activity found was due to a molybdenum-sesquisulfide-based lubricant. An extrapolation chamber has been used for surface dose measurements and results are presented. A network of fixed and mobile Bonner spheres is used for neutron dosimetry. Record keeping, use and maintenance for these is described. Deterioration of LiI(Eu) scintillators has been observed. The correlation of neutron film badge and Bonner sphere is described in different locations. The use of multisphere techniques in film badge calibration and fading compensation is presented. Tissue-equivalent ionization chambers are used for mixed field dosimetry. The eight inch chamber has been adapted to a "cutie pie" body to give an extremely useful portable instrument. ^{6}LiF and ^{7}LiF TLD pairs in the center of 2, 3, 5, 8, 10, 12, and 18 inch diameter spherical polyethylene moderators have been exposed to several gamma sources and a PuBe source, all of known intensity. Results of this calibration are discussed and conversion factors presented. (auth)

30228 EVALUATION OF FLUXES AND DOSE-EQUIVALENT RATES IN NEUTRON FIELDS AROUND HIGH ENERGY PROTON ACCELERATORS. Rindi, A. (Univ. of California, Berkeley). pp 397-427 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

An analysis is made of the errors involved in routine measurements of flux and dose equivalent around high-energy accelerators. By use of some typical neutron spectra from multidetector measurements made around the accelerators at the Lawrence Radiation Laboratory, Berkeley, and the proton synchrotron at CERN, Geneva, a calculation is made of the errors involved when only one detector is used for evaluating the total neutron flux and corresponding dose-equivalent rate. The correction factors to be applied to the routine measurements in these fields have been calculated, and a method is proposed for minimizing those errors. A CDC-6600 computer was used to make the calculations. (auth)

30229 TECHNIQUE FOR RAPID DETERMINATION OF DOSE EQUIVALENT RATES AT PARTICLE ACCELERATORS USING THE BONNER-SPECTROMETER. Price, K. W.; Holeman, G. R. (Yale Univ., New Haven). pp 429-447 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Neutron energy spectra were obtained near the Yale M. P. Tandem Van de Graaff Accelerator during scattering experiments.

Spectral measurements were performed using a Bonner-Spectrometer with 2, 3, 5, 8, 10 and 12 inch spheres with protons and deuterons as the accelerated particles. Neutron spectra were measured for various beam currents for a given beam energy and projectile. The most recent set of dose conversion factors was used in converting these measured energy spectra into a total absorbed dose and dose equivalent. The results obtained were then compared as to total neutron yield, total absorbed dose, and total dose equivalent. From the dose information average quality factors were calculated and compared. Extensive data were accumulated at one location near the accelerator and this information is presented in such a form as to allow for the rapid determination of the dose equivalent rate by knowing various machine parameters. (auth)

Auxiliaries and Components

Refer also to abstract 29778.

30230 (JINR-P9-7700) IMPEDANCE MEASUREMENT AND STUDY OF RESONANCE PROPERTIES OF COMPRESSOR CHAMBER. Barabash, L. S.; Dolya, S. N.; Petrov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The measurement procedure of the impedance is described. The data of this measurement are presented as well as of a study of the resonance properties of a compressor chamber, which determine the electron ring stability in a compressor of a collective heavy ion accelerator. (auth)

30231 (JINR-P9-7778) MEASUREMENT OF PULSE MAGNETIC FIELD DISTORTIONS AND ENERGY LOSS IN COMPRESSOR CHAMBER. Aleksandrov, V. S.; Barabash, L. S.; Bliskii, S. M.; Diveev, A. M.; Karzhavin, Yu. A.; Lachinov, V. M.; Lysyakov, V. N.; Makoveev, V. K.; Sarantsev, V. P.; Timokhin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.50.

The results are presented of a study of the distortions of pulsed magnetic fields of various duration and those of measurements of the energy loss in the walls and cylindrical surface of two models of the compressor chamber for a collective heavy ion accelerator. (auth)

30232 (KFK-1907) SUPERCONDUCTING HELIX SECTION FOR THE ACCELERATION OF PROTONS. Fricke, J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Jan 1974. 81p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

A 60-MeV superconducting proton linear accelerator is under construction. Superconducting helically loaded resonators are chosen for the energy range of 0.75 MeV up to 15 MeV. A specific property of the helix structure is its low mechanical stiffness. The electromagnetic fields cause deformations of the helix windings, resulting in a considerable change of eigenfrequency of the resonator. The influence of this effect ("radiation pressure") on the distribution of the accelerating field of the helix accelerator was investigated in an experiment on the first section of the superconducting helix accelerator and the results are discussed. (auth)

30233 (KFK-EXT-3/72-11, pp L1-15) APPLICATION OF HIGH FREQUENCY SUPERCONDUCTIVITY IN PROTON AND HEAVY ION ACCELERATORS. Kuntze, M. (Univ., Karlsruhe, Ger.). Oct 1972. (In German).

From application of superconductivity in electrical engineering and high energy physics conference; Titisee, Ger. (9 Oct 1972).

The dependence of the surface resistance on the temperature, frequency, and magnetic field intensity is discussed. Cost factors in the use of superconductors in accelerators are considered. The use of superconductors in the Karlsruhe linear accelerator is described. (JSR)

30234 COAXIAL BEAM-DIAGNOSTIC PROBE. Paulin, A. (SIN-ETH, Villigen, Switzerland). Nucl. Instrum. Methods; 116: No. 1, 197(1974).

The performance of the coaxial beam probe is improved by correct termination with the characteristic impedance of the coaxial probe. Test results are presented with 30 keV electron bunches at 50×10^6 pps. (WHK)

30235 FILTERING OUT THE RIPPLE FOR THE NIMROD SYNCHROTRON. Wheldon, A. (Science Research Council, Chilton, Eng.). Electron. Power; 20: No. 4, 148-151(7 Mar 1974)

Three methods devised for ripple elimination in the power supply of the 7-GeV proton synchrotron Nimrod are described. The first ripple filter is a closed-loop active system known as the primary ripple filter (p.r.f.), and reduces the ripple voltages developed across the magnet windings by introducing into the convertor plant output an alternating signal whose magnitude and phase are such that they oppose any power-supply ripple. The static ripple filter (s.r.f.) was specifically intended to offer very good smoothing during the flat-top period, and is an example of a passive system. It is usually operated in conjuction with the p.r.f., which then provides smoothing only during current rise. The frequency characteristics of the two filters already described do not extend far enough to cover the entire ripple spectrum. An examination of synchrotron performance showed that a particularly troublesome component was the second harmonic of the power-supply fundamental, i.e., about 100 Hz. To eliminate this single frequency from the power-supply output, a method was devised for controlling one convertor group in each half of the power supply to generate a 2nd-harmonic component in the power-supply output. This generated voltage was then adjusted in amplitude and phase to cancel out the unwanted ripple. (UK)

30236 NEUTRON SPECTRA OUTSIDE PROTON ACCELERATOR SHIELDING. Aleinikov, V. E.; Gerdt, V. P.; Komochkov, M. M. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 31-46 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

A method is proposed for unfolding the spectra of neutrons which have passed through the shielding of high-energy proton accelerators, using a Bonner spectrometer and an activation detector containing carbon. Measurements of neutron energy spectra outside the shielding of a 660-MeV proton synchrocyclotron and a 10-GeV proton synchrotron are presented. (auth)

30237 SHORT HIGH-FREQUENCY RESONATOR HAVING A LARGE FREQUENCY RANGE FOR CYCLOTRONS. Wierts, D.; Boomsma, P. (to U. S. Philips Corp.). US Patent 3,796,975. 12 Mar 1974. Priority date 29 Apr 1970, Netherlands. 8p.

An electric high-frequency resonator for accelerating charged atomic particles, comprising a first hollow conductor, a second hollow conductor extending within the first hollow conductor, a third hollow conductor extending within the second hollow conductor and a fourth hollow conductor extending within the third hollow conductor is described. The second and third hollow conductors and the first and fourth hollow conductors are connected respectively to form first and second waveguides for the propagation of high-frequency waves. Input coupling means are employed to connect the interposed first and second waveguides in series thereby providing increased electrical length characteristics for the propagation of high-frequency electric waves without increasing the structural length of the resonator. (Official Gazette)

30238 USE OF LOCAL SHIELDING IN EXPERIMENTAL CAVES AT A CYCLOTRON. Wadman, W. W. III. (Univ. of California, Irvine). pp 1291-1302 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-

Local shielding has been used to reduce successfully the radiation hazards in an experimental cave at the Berkeley 88 inch cyclotron to permissible levels at the cave barricade boundaries. Shielding research was performed with ion-beams of 50-MeV protons, 55-MeV deuterons, and 110-MeV alpha-particles. The target material used was tantalum. Total neutron flux, fast neutron flux, and neutron spectra as a function of depth in the shielding were measured with gold, nickel, aluminum and thallium reaction detectors. Attenuation measurements were made in ordinary density concrete. The front 12 inches was changed to iron and uranium to determine the effects of heavy materials on the subsequent attenuation in the concrete. The experimental results were used to design the smallest practical local shielding configurations consistent with quick access to the area and economy. Results of subsequent radiation measurements were then utilized to refine the shielding further in order to maintain levels of 2.5 mrem per hour or less at the closest barricades used to restrict cave access. Radiation dose measurements were determined by using the standard UCLRL two counter technique. (auth)

Ion Sources and Injection and Extraction Systems

30239 (AERE-R-7672) NEGATIVE ION SOURCES OF THE HARWELL TANDEM GENERATOR. Humphries, P. (UKAEA

Research Group, Harwell. Atomic Energy Research Establishment). Feb 1974. 11p. Dep. NTIS (U. S. Sales Only) $4.00.

The negative ion sources of the Harwell tandem generator have been progressively developed over the past 6 years. At present there are 3 completely separate ion-sources, each one capable of being operated in two different modes so that a very wide variety of negative ion beams can be produced. Those which have been accelerated include negative ions of p, d, He, Li, B, C, O, F, Al, S, Cl, Fe, Ni, Cu and Zr. A number of other ion species are also possible. (auth)

30240 (CEA-R-4546) STUDY OF THE ADAPTATION OF AN EXTERNAL HEAVY ION SOURCE WITH THE GRENOBLE ISOCHRONOUS CYCLOTRON. Raliu, G. A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Feb 1974. 132p. (In French). Dep. NTIS (U. S. Sales Only) $9.75.

Thesis.

After studying the possibilities of accelerating heavy ions in the isochronous cyclotron at Grenoble, an internal Penning-type source was chosen. The possibility of placing such a source outside the cyclotron was also examined. Two ways of extracting the ions from the magnetic field of the external source were studied. With the first method the ions are guarded in the median plane, and the curvature of the trajectories is inverted. With the second an inflector is used to deflect the ions vertically through a hole in one pole of the source magnet. In addition, a device for measuring emittances in a magnet field was specially developed for these studies. In conclusion, both methods enable heavy ions to be injected from the external source on the Grenoble cyclotron under good conditions. (auth)

30241 (DESY-73-63) PROTOTYPE POLARIZED ELECTRON SOURCE THROUGH ELECTRON–HYDROGEN SPIN-EXCHANGE WITH TEFLON CONTAINMENT OF HYDROGEN AND A LONGITUDINAL MAGNETIC TRAP. Krisciokaitis, R.; Peterson, W. K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1973. 23p. Dep. NTIS (U. S. Sales Only) $4.25.

A prototype polarized electron source was constructed and results are reported. It is based on electron-hydrogen spin-exchange collisions using a longitudinal geometry electron trap and teflon coatings to contain the state-selected atomic hydrogen target. This scaled-down prototype is compatible with an electron linac and produces an extracted pulse of about 10^7 electrons/μs with about 60% polarization and 50 to 60 Hz repetition rate. Construction of a more intense (10^{10} or more electrons per pulse) full scale device based upon this technique is also discussed. The average measured total electron-hydrogen spin-exchange cross-section for 5 to 10 eV electrons is estimated to be in the range 0.5 to 1.55×10^{-15} cm^2. (auth)

30242 (RL-74-23) SWITCHING MAGNET PROFILE AND DIMENSIONS. Armstrong, A. G. A. M. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Feb 1974. 4p. Dep. NTIS (U. S. Sales Only) $4.00.

The profile and dimensions of a magnet suitable for rapid switching of the extracted Nimrod beam were determined by close collaboration on all aspects of the switching system, and by use of the TRIM program. (auth)

30243 MODIFICATION OF A SPUTTER ION SOURCE FOR VAN de GRAAFF OPERATION. Hirvonen, J. K. (Naval Research Lab., Washington, DC). Nucl. Instrum. Methods; 116: No. 1, 9-11(1974).

The modification of a sputter ion source of Hill–Nelson design for operation in a 5-MV VDG accelerator is described and its performance is discussed. The modified ion source has produced stable ^{58}Ni ion beams of several microamperes intensity at 3 MeV with acceptable filament and source-part lifetimes. (auth)

30244 SOURCE OF POLARIZED ^{3}He IONS. Burcham, W. E.; Karban, O.; Oh, S.; Powell, W. B. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 116: No. 1, 1-7(1974).

The principles of a polarized $^3H^{2+}$ source based on the Lamb-shift of the n = 2 state in the $^3He^+$ ion are described. It is estimated that about 10 nA of $^3H^{2+}$ with a polarization of 35% ($P^2I \approx 4 \times 10^8$ particles s^{-1}) might be made available for axial injection into a cyclotron. (auth)

30245 POWER AND PARTICLE FLUX BALANCE IN P.I.G. DISCHARGE ION SOURCE. Part 1. Ion Containment. Green, T. S.; Goble, C. (Culham Lab., Abingdon, Eng.). Nucl. Instrum. Methods; 116: No. 1, 157-163(1974).

Optimization of the operation of a P.I.G. discharge ion source for the production of multi-charged ions requires the use of a high power input into the discharge plasma, and good containment of the ions. Experimental data on the operating conditions of a P.I.G. source are analyzed in terms of power and particle flux balance using the model of the source presented by Basile and Lagrange in order to determine the power input to the plasma. From an extension of the analysis it is possible to estimate the ratio of the radial ion loss rate to the axial ion loss rate. A study of the variation of this ratio with magnetic field indicates those mechanisms which are responsible for the loss of ions from the source. (auth)

30246 POWER AND PARTICLE FLUX BALANCE IN P.I.G. DISCHARGE ION SOURCE. Part 2. Ionization. Green, T. S.; Goble, C. (Culham Lab., Abingdon, Eng.). Nucl. Instrum. Methods; 116: No. 1, 165-168(1974).

The ion current which can be extracted from an ion source depends on the degree of ionization of the neutral gas which can be attained. An analysis is presented of the ionization in a P.I.G. discharge ion source, in which it is assumed that ionization is due dominantly to the impact of thermal electrons with neutral atoms. Implications of this analysis for the operating conditions of the source are discussed and comparison is made with experimental data. (auth)

Ion Optics and Field Calculations

Refer also to abstract 30771.

30247 EFFECT OF VERY SMALL IRREGULARITIES AT THE POLE FACES OF A CYCLOTRON MAGNET ON THE QUALITY OF THE ION BEAM. Van Nieuwland, J. M. (Philips Research Labs., Eindhoven, Netherlands); Hagedoorn, H. L. Nucl. Instrum. Methods; 116: No. 1, 13-16(1974).

The variations of the magnetic induction in the median plane of a cyclotron magnet induced by small grooves (e.g., 25 μm modulation) at the iron surface are calculated. The stochastic variation of the field index due to these field disturbances has a deteriorating effect on the beam quality when the distance between successive orbits is larger than some typical radial interval within which a field variation changes in sign. An approximative calculation of this effect is presented and it is shown that, under certain circumstances, the beam quality seriously deteriorates. (auth)

Storage Rings

Refer also to abstract 29464.

30248 (FRNC-TH-454) FREQUENCY MULTIPLYING ELECTRON COLLISION RING. Gournay, J. F. (Paris-11 Univ., 91 - Orsay (France)). 1972. 107p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis.

An electron collision ring project intended for the production of synchrotron radiation detectable at wavelengths of several microns is discussed. The ring will replace the frequency multiplying diodes used in measurements for the unification of the 9×10^9 Hz Cs line time standard and the 5×10^{14} Hz krypton line length standard. The solution studied enabled a jump to be effected from a microwave frequency to an optical frequency using a single frequency multiplication. The 3×10^{13} Hz ($\lambda \approx 10$ μ) frequency selected from the synchrotron spectrum emitted is the smallest frequency capable of being related to the standard meter line using an interferometric process. This is accomplished by producing packets of particles, the lengths of which diminish with decreasing wavelength. These packets must be sufficiently populated. The following difficulties were encountered: an unacceptable temperature tolerance; an insufficiently long beam lifetime; an inadequacy in obtaining the desired value of the eta coefficient and hence a highly insufficient radiated power. Studies are currently being conducted in order to complete the project undertaken. (FR)

30249 (RL-74-15) EPIC TRANSFER LINES. Jones, B. D. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Jan 1974. 12p. Dep. NTIS (U. S. Sales Only) $4.00.

A preliminary design of transfer lines for EPIC is described based on the following requirements: (a) the transfer lines should conduct electrons and positrons/protons of 5 GeV/c from the Nina booster to the main storage rings with, for electrons and positrons, exchange of the horizontal and vertical emittances; (b) the layout should be consistent with the relative positions and orientations of the booster and main rings indicated by site considerations; and (c) existing DNPL/RHEL beam components, which would become available with the shut-down of the present accelerator facilities, should be used where possible to achieve cost savings. (UK)

30250 π–μ SEPARATION WITH A 235 g/cm^2 FILTER. Dakin, J. T.; Feldman, G. J. (Stanford Linear Accelerator Center, CA). Nucl. Instrum. Methods; 116: No. 2, 323-327(1974).

The system for distinguishing π's from μ's in the SPEAR magnetic detector is described. The probabilities for misidentifying a π as a μ and a μ as a π are determined experimentally. (auth)

30251 LUMINOSITY MEASUREMENT AT ADONE BY SINGLE AND DOUBLE BREMSSTRAHLUNG. Dehne, H. C. (DESY, Hamburg); Preger, M. A.; Tazzari, S.; Vignola, G. Nucl. Instrum. Methods; 116: No. 2, 345-359(1974).

The luminosity of the electron-positron colliding beam storage ring Adone has been measured detecting single and double beam-beam bremsstrahlung simultaneously. The two methods are in agreement within experimental errors of the order of ±2.5%. A third luminosity measurement, using small angle Bhabha scattering, was also found to be in agreement with the previous two. (auth)

Experimental Facilities

Refer also to abstracts 29535 and 29610.

30252 (INIS-mf-1020) DESCRIPTION OF THE NEUTRON GENERATOR. Experiments with Pulsed Neutrons. Kepinski, A.; Soto, J. B. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil). Divisao de Reactores). Sep 1971. 25p. (In Portuguese). INIS.

A general description is given of the basic method of obtaining neutrons through the T(d,n)α and D(d,n)He reactions using the 150 KV Texas Nuclear linear accelerator at IEN. The method of measuring the 14-MeV absolute neutron flux using the (n,2n) reaction in ^{63}Cu is described. The theory of pulsed neutron source method is given together with details of the experimental techniques to obtain the nuclear parameters of moderating media. (INIS)

30253 (JINR-P13-7657) BEMS-2 ON-LINE ISOTOPE SEPARATOR AT THE JINR HEAVY ION CYCLOTRON. Karnaukhov, V. A.; Dem'yanov, A. V.; Bogdanov, D. D.; Koval, G. I.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.25.

The BEMS-2 on-line isotope separator operated in a heavy ion beam employs a high-temperature surface-ionization ion source. The design features of the ion source together with an external target are described. The recoil effect occurring in heavy ion reactions is used to transport the radioactive isotopes under investigation into the source cavity through a thin, 1.4 μm, tantalum entrance foil. The operational characteristics of the ion source for Cs and Ba isotopes are studied. The average hold-up time of the activity in the ion source, τ, which is determined by the diffusion of recoils from the collector, is measured. The value of τ depends on the temperature and type of the collector used. For a tantalum collector $\tau \cong 1.0$ sec at T = 2500°C and the value of τ increases with decreasing temperature. In the case of a tungsten collector, the hold-up time is several times longer. The ion source efficiency for Ba is equal to 30 to 50%. (auth)

30254 (LA-5529-MS) TIME-OF-FLIGHT MEASUREMENTS AT THE LAMPF LOW-ENERGY PION CHANNEL. Cooper, M. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

Particle identification by time-of-flight techniques was carried out using flight paths between two scintillation counters and between one such counter and the 200-MHz rf structure of the primary proton beam striking the meson production target. With the low-energy pion channel at 103 MeV/c, the two-counter technique yielded clean separation of pions, muons, and electrons. At 195 MeV/c, the rf technique measured the energy resolution of the primary proton beam to be as good as 0.14% FWHM. (auth)

30255 (LNF-73-36) ENERGY LOSS SPECTROMETER FOR LOW ENERGY PION SCATTERING. Barbini, R.; Faini, S.; Guaraldo, C.; Schaerf, C.; Scrimaglio, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Nov 1973. 23p. Dep. NTIS (U. S. Sales Only) $4.25.

The performance of an energy loss spectrometer is reported together with a detailed discussion of the basic parameters of such a system and in particular the second order aberrations. The system consists of two uniform field seventy degree bending sectors in a configuration symmetrical to first order, with an image point in the symmetry plane. The system has been tested with the LEALE-LNF low energy positive and negative pion beams. The magnets were set at zero degrees facing each other. The contributions of the aberrations and of multiple Coulomb scattering in air, helium, and thin windows to the momentum resolution of the two magnets system have been evaluated and the total momentum resolution compared with the experiment at various energies for positive and negative pions. (auth)

30256 (LNF-73-38) DESIGN OF A SOFT X-RAY GRAZING INCIDENCE MONOCHROMATOR FOR SYNCHROTRON RADIATION. Piacentini, M.; Strinati, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 27 Jun 1973. 19p. Dep. NTIS (U. S. Sales Only) $4.00.

Commercial monochromators do not completely match the special characteristics of synchrotron radiation. A new design for a soft x-ray monochromator for synchrotron radiation is described. This monochromator offers many advantages: second orders elimination on the whole spectral range, fixed position of the sample, high resolution and remarkable versatility. (auth)

30257 (LNF-73-59) MEA-MAGNETIC FIELD MEASUREMENTS. Ogren, H.; Mariani, A.; Bisello, D. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 8 Oct 1973. 34p. Dep. NTIS (U. S. Sales Only) $4.75.

The magnet experiment at Adone (MEA) will provide a comprehensive study of e^+e^- interactions, including pion and kaon form factors, e^+e^- and $\mu^+\mu^-$ final state cross sections with charge recognition, and the cross sections for all hadron final states with charged multiplicity $\geq$ two. The experimental apparatus consists of a mixture of counters, narrow gap and wide gap chambers, and proportional chambers. The prominent feature is a large solenoid magnet with a radius of one meter and a length of two meters. This solenoid is mounted transversely to the e^+e^- beams and has a maximum central field value of ~5000 gauss. Without a compensation system each of the beams would see ~10,000 gauss-meters of field integral. A pair of compensator magnets attached in series electrically with the main bobbin surrounds about 50% of the beam path inside the solenoid and must reduce the net field integral to zero. The measurement of the field integral and the field throughout the entire solenoid volume is reported. This field map will be needed for an accurate momentum determination of the final state particles. (WHK)

30258 (RL-74-33) K17: A SEPARATED LOW MOMENTUM KAON BEAM AT NIMROD. An Interim Report. Batty, C. J.; Craddock, M. K.; Reason, C. J.; Riddle, R. A. J.; Welsh, R. E.; Worledge, D. H.; Eckhause, M.; Berovic, N.; Pyle, G. J.; Squier, G. T. A.; Clough, A. S.; Turner, G. K. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Feb 1974. 12p. Dep. NTIS (U. S. Sales Only) $4.00.

A high intensity separated low momentum kaon beam has been built at Nimrod. Preliminary figures for yields and π/K ratios are presented. (auth)

30259 (UH-511-145-73) NEUTRON BEAM MONITOR FOR NAL EXPERIMENT 87. Yount, D. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Feb 1973. Contract AT(04-3)-511. 14p. Dep. NTIS $4.00.

A layered scintillator-iron shower counter for neutron beam monitoring at the NAL Synchrotron is described. The 100-GeV hadron cascade in iron is plotted, and the operation, efficiency, and energy resolution are discussed. (WAK)

30260 (UH-511-163-73) HYBRID BUBBLE-CHAMBER DETECTION OF NEUTRINO EVENTS: THE EXTERNAL MUON IDENTIFIER. Peterson, V. Z. (Hawaii Univ., Honolulu (USA)). 1973. Contract AT(04-3)-511. 3p. Dep. NTIS $3.00.

High energy neutrino interactions in hydrogen, in particular deep inelastic scattering $\nu p \rightarrow \bar{\mu} p y^+$ (y^+ = any meson system) will be studied at NAL using the 30-m^3 bubble chamber as soon as the chamber is working and the neutrino beam is sufficiently intense. Identification of the muon is fundamental in the analysis of each event. Kinematic analysis often has been sufficient for muon identification in simple topologies with low energy neutrinos. As the neutrino energy increases and the event becomes more complex, however, it is necessary to require more positive identification of the muon among many outgoing prongs. The "EMI" (External Muon Identifier) was proposed by the LBL-Hawaii collaboration to meet this need. NAL "Experiment 155" is the development and test of the EMI as part of the 15-foot bubble-chamber facility at NAL. The EMI is also expected to be of use with other chamber fillings (D_2, neon, etc.). The EMI is basically an array of multiwire proportional chambers (MWPC) located behind the bubble chamber over a large enough area (30 m^2) to intercept most of the muons emerging from neutrino interactions in the hydrogen fiducial volume. (WHK)

30261 (UH-511-165-73) NAL 30 m^3 BUBBLE CHAMBER EXTERNAL MUON IDENTIFIER. Harris, F. A. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Oct 1973. Contract AT(04-3)-511. 12p. (CONF-730856-1). Dep. NTIS $3.00.

From fifth topical conference in partical physics; Honolulu, Hawaii, USA (8 Aug 1973).

The Hawaii-LBL collaboration has accepted the responsibility of building an external muon identifier (EMI) behind the 15′ bubble chamber at NAL. The basic idea of the EMI is to use a single plane of multiwire proportional chambers (MWPC) to detect the positions of particles emerging from an absorber behind the 15′ bubble chamber. The incident direction and momentum are determined by analyzing the bubble chamber film. By extrapolating the trajectory through the magnetic field, it is possible to predict where each particle should intersect the plane of MWPC's. The development and testing of the EMI are briefly discussed. (WHK)

30262 SYNCHROTRON AS A RADIATION STANDARD FOR THE VACUUM ULTRAVIOLET. Rusbueldt, D.; Thimm, K. (Kernforschungsanlage, Juelich, Ger.). Nucl. Instrum. Methods; 116: No. 1, 125-140(1974).

At the 2.5 GeV synchrotron of the University of Bonn, a facility has been established to take advantage of the synchrotron radiation. The spectral and angular distribution of the radiation has been computed numerically using the well known formulas of Schwinger. A simple derivation of these formulas which are extended to include the polarization, is presented. By the use of fast converging expansions for the Bessel functions involved, it was possible to fit the numerical evaluation to modern desk-top computers. To confirm the calculations, the intensity of the synchrotron radiation has been determined absolutely in the visible by comparison with a carbon arc. Then the spectral sensitivity of a 0.5 m Seya-Namioka monochromator combined with a focusing mirror and a detector has been calibrated by means of the synchrotron radiation for both directions of polarization. Using this arrangement, the radiation emitted from a plasma generated by a fast sliding spark through a polyethylene capillary (kT_e = 35 eV, $n_e = 2.5 \times 10^{19}$ cm^{-3}) has been investigated. The spectral dependence of the continuous radiation between 540 Å and 9000 Å has been found to be in good agreement with the theory. (auth)

30263 FACILITY FOR CALIBRATIONS AND SHORT EXPERIMENTS WITH HEAVY IONS AT THE BEVATRON. Greiner, D. E. (Univ. of California, Berkeley); Lindstrom, P. J.; Bieser, F. S.; Heckman, H. H. Nucl. Instrum. Methods; 116: No. 1, 21-24(1974).

Heavy-ion beams at the Lawrence Berkeley Laboratory Bevatron are routinely available for calibration purposes. These beams are very useful to cosmic-ray physicists and others who wish to have empirical evidence indicating their instruments really can identify elements or isotopes. Virtually all isotopes through ^{86}O can be produced over a wide energy range. (auth)

30264 HIGH-PRESSURE GAS CELL FOR DSA LIFETIME MEASUREMENTS. Schaile, O.; Grawe, H.; Koenig, R. (Univ., Freiburg i. B.). Nucl. Instrum. Methods; 116: No. 1, 185-187 (1974).

A high-pressure gas cell for DSA lifetime measurements is described. Lifetimes in ^{17}O and ^{43}Ca were measured and the results are found to depend systematically on the beam intensity. (auth)

30265 SPECTRAL DISTRIBUTION OF NEUTRONS OUTSIDE THE SHIELDING OF NEUTRON GENERATORS. Sauermann, P. F.; Schaefer, W. (Kernforschungszentrum, Juelich, Ger.). pp 23-29 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The spectral distribution of neutrons escaping from the target room of a neutron generator was measured by the difference method The results show that the spectrum of the neutrons coming from the labyrinth is similar to that obtained for those penetrating the shield, i.e., intermediate neutrons are predominant in the radiation field outside the shielding and inside the labyrinth of neutron generators. (auth)

30266 CRYOGENIC TARGET FOR A ^{2}H(γ,n) PHOTON SPECTROMETER. Sherman, N. K. (National Research Council of Canada, Ottawa). Nucl. Instrum. Methods; 116: No. 2, 301-315 (1974).

A cryogenic target facility built for use at the N.R.C. electron linear accelerator is described. It has been designed to provide a 265 ml volume of liquid deuterium in the form of a horizontal cylinder which can be irradiated by bremsstrahlung. It is suitable for liquefaction of hydrogen or neon also, and has been so used. When ^{2}H(γ,n) photoneutrons are detected by the time-of-flight technique with a resolution of 0.4 ns/m or better, the apparatus constitutes a useful spectrometer for photons in the energy range from 5 to 50 MeV. The advantages of using liquid $^2H_2$ are pointed out, and are illustrated by the low background achieved with a polyimide plastic target of light construction cooled to about 20°K by means of a commercial He refrigerator. The absence of density changes due to beam-induced boiling of the liquid is demonstrated. For a total power input to the vacuum pump and refrigerator of about 6 kW, a refrigerator power of 12.6 W at 23.6°K was obtained. The liquefaction rate of gas supplied at 300°K was 2.65 ml of $^2H_2$ per minute, after a cool-down time of less than 1 h after start-up. The He refrigerator and compressor have given over 1660 h of trouble-free operation to date: 360 h of experimentation with $^1H_2$, 860 h with $^2H_2$, and 450 h with Ne. One target was cooled down 5 times from 300°K to below 20°K and irradiated with bremsstrahlung for a total of about 200 h over a six-month period, without loss of structural integrity. Results of measuring the bremsstrahlung spectral shape from a Ta radiator 0.51 mm thick irradiated with 25 MeV electrons are described, and are found to agree quite well with the zero-angle, thin-radiator predictions of Schiff. Extensive references to the subject of ^{2}H photodisintegration are given. The superiority of the ^{2}H(γ,n)$^1H_1$ reaction as a photon spectrometer reaction in the MeV energy range is emphasized. (auth)

30267 ON-LINE BETA-RECOIL MASS SPECTROMETRY (MAGGIE). Macfarlane, R. D.; Torgerson, D. F.; Fares, Y.; Hassell, C. A. (Texas A and M Univ., College Station). Nucl. Instrum. Methods; 116: No. 2, 381-388(1974).

A new approach to "on-line" mass identification of short-lived nuclides is described. The method is based on a time-of-flight measurement of β-recoil ions accelerated from near rest to a fixed kinetic energy. Results have been obtained for flight paths ranging from 25 to 800 cm. The shorter flight lengths give a resolution sufficient for adjacent mass identification and the longest flight path may be used to measure atomic masses of the β-recoils. (auth)

30268 SIGN-SELECTED DICHROMATIC NEUTRINO BEAM. Limon, P. (National Accelerator Lab., Batavia, IL); Stefanski, R.; Teng, L. C.; Yamanouchi, T.; Windelborn, A. Nucl. Instrum. Methods; 116: No. 2, 317-321(1974).

A sign-selected dichromatic neutrino beam using conventional magnets presently in use at NAL is described. The beam has a solid angle acceptance of ten μsr and can focus charged hadrons up to a momentum of 170 GeV/c. The beam can be used to select either neutrinos or anti-neutrinos: when focused for neutrinos, the anti-neutrino contamination is less than 0.001 for neutrino moments greater than 40 GeV/c; when the beam is focused for anti-neutrinos, the neutrino background is 0.01 over most of the momentum range. The beam has a provision for momentum selection which produces a dichromatic neutrino beam—a beam focused into two momentum bands. (auth)

30269 SIMPLE CORRECTION FOR Q-METER MEASUREMENT OF PROTON TARGET POLARIZATION. Hill, J. J.; Hill, D. A. (Argonne National Lab., IL). Nucl. Instrum. Methods; 116: No. 2, 269-274(1974).

The Q-meter measurement of polarization for polarized proton targets was computer-simulated for Lorentzian, Gaussian, and real line shapes, using the dispersion relations to calculate susceptibilities. The enhancement calculated in the usual way by neglecting dispersion, cable and frequency effects, was compared to the true enhancement of the NMR signal. Both the error in the calculated polarization and the signal size were found to vary considerably with all the parameters and line shapes but the error as a function of signal size was almost independent of circuit parameters with only slight dependence on line shape, allowing the error to be found if signal size alone is known. (auth)

30270 NEUTRON GENERATORS. Stark, D. S. (to Nationale Research Development Corp.). US Patent 3,794,875. 26 Feb 1974. Priority date 30 Dec 1969, United Kingdom of Great Britain and Northern Ireland. 6p.

In a sealed-off neutron generator containing tritium, for the production of neutrons by the D−T reaction, helium-3 gas accumulates owing to radioactive decay of the tritium and interferes with the proper operation of the generator. In the present generator a sputter-ion pump is sealed to the generator to remove the helium-3 from the envelope prior to admitting hydrogen isotope gas from the usual replenisher before use. The pump is adapted to remove only the unwanted helium-3 and not the wanted D and T, by having its sputterable cathodes made of, or coated with, a metal which has a low chemical affinity for hydrogen but is readily sputtered by helium, such as copper. (Official Gazette)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 29463 and 30328.

30271 (AD-763124) COSMIC RAYS EFFECTIVE CUT-OFF RIGIDITIES. Dorman, L. I.; Gushchina, R. T.; Shea, M. A.; Smart, D. F. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 12 Jul 1973. 155p. (In English and Russian). (AFCRL-TR-73-405). NTIS $9.75.

The book contains the results of calculations of cosmic-ray effective cut-off rigidities in real magnetic field. Use is made of the results of trajectory calculations of the penumbra function. The results of the effective cut-off calculations are presented for the whole network of cosmic-ray stations in the USSR and abroad and for expedition studies. The tables are also presented which determine the dependence of effective cut-off rigidities on the type of detectors and their variations as expected for various cosmic-ray variations. (GRA)

30272 (AD-770119) ANOMALOUS RESISTIVITY IN THE AURORAL PLASMA. Papadopoulos, K.; Coffey, T. P. (Naval Research Lab., Washington, D. C. (USA)). Oct 1973. 17p. (NRL-MR-2661). NTIS $2.75.

The stabilization of fast precipitating electron bursts in the auroral plasma by parametric spectral transfer of waves out of their region of generation results in a nonlinear equilibrium, composed of an enhanced wave spectrum of high frequency oscillations and very low frequency ion density fluctuations. It is shown that the wave particle scattering due to the enhanced spectrum of the low phase velocity ion fluctuations can increase the d.c. resistivity of the auroral plasma by several orders of magnitude. (auth)

30273 (COO-3071-66) ORIGIN OF COSMIC RAYS. Cohen, J. M.; Ramaty, R. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 27 Feb 1974. 6p. Dep. NTIS $4.00.

Presented is a model in which cosmic electrons (>100 MeV) are produced by pulsars, and cosmic protons and alpha particles are accelerated by shock waves in supernova envelopes. It is argued that neither mechanism by itself can produce both the observed protons and electrons at energies above a few hundred MeV. But supernova accelerated electrons could constitute the majority of cosmic electrons with energy below about 10 MeV. (auth)

30274 (LUIP-CR-74-1) COMPOSITION OF THE COSMIC RADIATION AND THE ATOMIC PROPERTIES OF THE ELEMENTS. Kristiansson, K. (Lund Univ. (Sweden). Fysiska Institutionen). Feb 1974. 31p. Dep. NTIS (U. S. Sales Only) $4.75.

The composition of the primordial cosmic radiation has been compared with the solar system composition and that of interstellar matter. It is found that the overabundance of an element in the radiation is approximately proportional to the cross section for the ionization of neutral atoms of that element through fast charged-particle impacts. The results strongly support the assumption that the selection of cosmic-ray particles is governed by the atomic properties of the elements. (auth)

30275 LECTURES ON SPACE PHYSICS. I. Cosmic Rays and Space Biophysics. Bruzek, A.; Pilkuhn, H. (eds.). Duesseldorf; Bertelsmann Universitaetsverlag (1973). 353p. DM 30,--.

From Sept. 4 to 24, 1972, the German Physical Society arranged four courses on space physics at Titisee, Black Forest. The courses were organized primarily for students and nonspecialists in the field. This volume represents an outgrowth of the lecture notes on cosmic rays and space biophysics. (WDM)

30276 ASTROFIZIKA VYSOKIKH ENERGII. (High Energy Astrophysics). Ozernoi, L. M.; Prilutskii, O. F.; Rozental, I. L. Moscow; Atomizdat (1973). 248p.

The theory of the processes of interaction of high-energy particles existing in the Universe is examined. Experimental data on processes occurring in stars, the galaxy, and metagalaxy and registered outside of the optical range (infrared, x-ray, and γ astronomy) are reported. The interpretation of these data is examined in detail. (tr-auth)

30277 THREE-DIMENSIONAL COSMIC RAY ANISOTROPY IN INTERPLANETARY SPACE. 4. Origin of Solar Semi-Diurnal Variation. Nagashima, K.; Fujimoto, K.; Fujii, Z.; Ueno, H.; Kondo, I. (Nagoya Univ., Japan). Rep. Ionosphere Space Res. Jap.; 26: No. 1-2, 31-68(Jun 1972).

The origin of solar semi-diurnal variation of cosmic-ray intensity is studied on the basis of the analytical method developed in Parts I and II, which utilizes the annual modulation of daily variation due to the earth's revolution around the Sun. Data used for the analysis are those of the multi-directional large area cosmic-ray telescope at Mt. Norikura, which can be made insensitive to the atmospheric effects by taking differences among intensities of different directions. Similar to the conclusion in Part III, the result of the present analysis gives positive support to the pitch angle distribution hypothesis and eliminates the possibility of density gradient hypothesis for the explanation of solar semi-diurnal variation. The space distribution obtained is of $\sin^2 \chi$-type, its reference axis of anisotropy being in the direction of interplanetary magnetic line of force, where χ is the angle between the reference axis and the cosmic-ray incident direction. The rigidity spectrum is of power-exponential type with its maximum at about P_M = 60 to 100 GV. (auth)

30278 INVESTIGATION OF COSMIC RAYS IN THE STRATOSPHERE. Charakhch'yan, A. N.; Charakhch'yan, T. N. pp 3-48 of Primary Cosmic Radiation. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The principal results of more than 20,000 systematic cosmic-ray measurements in the stratosphere, starting with 1957, are discussed. The intensities and energy spectra of the various cosmic-ray components in the Earth's atmosphere, and of primary cosmic rays at the atmospheric boundary are examined. The eleven-year solar modulation of galactic cosmic rays in interplanetary space is studied. (IAA)

30279 PERVICHNOE KOSMICHESKOE IZLUCHENIE. (Primary Cosmic Radiation). Skobel'tsyn, D. V. (ed.). Trudy Fizicheskogo Institute, Akademiya Nauk SSSR, Volume 64. Moscow; Izdatel'stvo Nauka (1973). 100p.

The papers deal with various problems associated with the variation of total cosmic-ray intensity and with the mechanisms of cosmic-ray generation. Experimental data on cosmic-ray fluxes in the stratosphere are examined, along with theoretical models of cosmic-ray generation mechanisms in solar flares. Modern methods used in experimental studies of cosmic rays are reviewed and compared. (IAA)

30280 COSMIC-RAY SCINTILLATIONS. Owens, A. J. Pasadena, CA; California Inst. of Tech. (1973). 197p. University Microfilms Order No. 73-31,053.

Thesis (Ph. D.).

The observation and theoretical interpretation of a new physical phenomenon are reported. Cosmic-ray "scintillations" are temporal fluctuations in the counting rate of a detector pointing in a fixed direction in space. Power-spectral analyses of energetic-particle counting rate data are used to demonstrate that scintillations are a statistically significant, persistent, and interesting feature of the cosmic-ray flux observed near Earth for a wide range of frequencies and energies (~1 MeV to 10 GeV protons, 3 to 12 MeV electrons). The observed power spectra of cosmic-ray scintillations are approximately power laws in frequency with exponents of -1.5 to -2.0, and for protons the relative scintillations are a rapidly decreasing function of energy. (WDM)

30281 MEASUREMENT OF THE COSMIC RAY MUON CHARGE RATIO IN THE VERTICAL DIRECTION AND AT 50 TO 90° EAST IN THE MOMENTUM RANGE 3 TO 20 GeV/c. McAdams, T. H. College Station, TX; Texas A and M Univ. (1973). 222p. University Microfilms Order No. 74-1030.

Thesis (Ph. D.).

The cosmic-ray muon charge ratio at sea level was examined in the momentum range 3 to 20 GeV/c in the vertical direction and at 50 to 90° East. The measurements were made with a digitized Geiger counter hodoscope mounted on a solid-iron magnetic momentum spectrometer. This hodoscope was developed for this experimental study and provided automatic recording of muon trajectory information on magnetic tape. The recording of data in digitized computer compatible form allowed the analysis of approximately 100,000 muon events. A data analysis procedure was developed which provided more detailed information from the hodoscope data than could be derived by conventional procedures to date. Details of the experimental apparatus and the methods of data analysis are discussed. Muon charge ratios as small as 0.1 were observed at the largest zenith angles whereas the vertical charge ratios were near a constant value of 1.25. These experimental results are compared with the predictions of a muon production and propagation model which accounts for the geomagnetic deflection of muon trajectories. Due to the low

range of momentum studied, the model predictions were carefully corrected for multiple Coulomb scattering in the atmosphere. (Diss. Abstr. Int., B)

30282 ORIGIN OF ENERGETIC COSMIC RAYS. I. Galactic Diffusion in the Energy Range 10^{14} to 10^{17} eV. Bell, M. C.; Kota, J.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 3, 420-436(11 Feb 1974).

A brief survey is given of measurements leading to the determination of the energy spectrum of primary cosmic rays in the energy range 10^{14} to 10^{17} eV with particular reference to the change of exponent which occurs in the region of 3×10^{15} eV (the spectral "kink") and an attempt is made to give a quantitative explanation in terms of galactic diffusion. Reasonable astronomical values for various parameters (cloud sizes, magnetic fields, etc) give some measure of success in accounting for the sharpness of the kink in the energy spectrum, the energy at which it occurs and the magnitude of the change of exponent. Problems arise with the predicted anistropy however and the adopted model breaks down above about 10^{17} eV. (auth)

30283 ORIGIN OF ENERGETIC COSMIC RAYS. II. Possibility of a Contribution From Pulsars. Karakuka, S. (Univ. of Durham, Eng.); Osborne, J. L.; Wdowczyk, J. J. Phys., A (London); 7: No. 3, 437-443(11 Feb 1974).

The form of the primary cosmic-ray spectrum expected from pulsars is derived using the model of Ostriker and Gunn (Astrophys. J.; 157: 1395-417 (1969)) for pulsar characteristics and experimental data on pulsar frequencies. It is found that in the energy range 10^{14} eV to 10^{16} eV (i.e., in the region covering the break in the primary spectrum) the majority of cosmic rays could come from pulsars. The shape of the spectrum is such as to go some way towards explaining the rapid change of slope which is found to occur at about 3×10^{15} eV. The pulsar contribution appears to cease above 3×10^{16} eV and some other source is necessary here; similarly other sources are needed below about 10^{14} eV. (auth)

30284 MEASUREMENT OF THE SUPERHEAVY NUCLEI IN PRIMARY COSMIC RAYS BY SOLID TRACK DETECTORS, X-RAY FILMS, AND NUCLEAR PLATES. Doke, T. (Waseda Univ., Tokyo); Okamoto, H.; Shibamura, H.; Ito, K.; Yanagimachi, T. Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 9: No. 1, 273-296 (Mar 1973). (In Japanese).

This paper describes preliminary and basic experiments on the measurement of superheavy nuclei. The detectors used were plastic films, x-ray films and nuclear plates. Energy calibration of the tracks observed on the plastic films was performed by using tracks of fission fragments. Errors in the identification of nuclides were estimated to be $|\Delta A| \sim 4$, and $|\Delta Z| \sim 2$. Nitrogen ions accelerated by a cyclotron were also used for the calibration. Since the cut-off energy in Japan is around 5 GeV/nucleon, information on the velocity (β) of heavy particles was not necessary for the determination of nuclear charge. The x-ray films were used for the detection of the nuclei around iron. It was examined to estimate the nuclear charge from the width of flight tracks and to estimate velocity from the spatial distribution of blackening probability. The area of the detectors used for the balloon flight was 50 cm × 40 cm, and the detectors consisted of plastic films and x-ray films. Nuclear plates were also used for the determination of the nuclear charge of particles. The flight time was around 7 hours and 50 min. Charge distribution was obtained by scanning the nuclear plates. Intensity of the iron in primary cosmic ray was $10^{-1}/m^2 \cdot sr \cdot sec$. The heavy particles were measured by the plastic films. The charge of the observed heavy particles was 47 ± 5, and was consistent with the value $47 \pm$ observed by the x-ray films. Other particles were observed by the x-ray films, and the charge was 40 ± 8.5. Another balloon flight is planned and investigated. (JA)

30285 MULTIPLE SCATTERING OF ATMOSPHERIC MUONS AT LARGE ZENITH ANGLES. Torsti, J. J. (Turku Univ., Finland). Ann. Univ. Turk., Ser. A1; No. 162, 35-42(Sep 1973).

Different estimates were calculated for the effects of multiple scattering on the sea-level muon intensities in the momentum range 1 to 100 GeV/c at zenith angles 80°, 84°, and 88°. According to the most accurate estimation, these effects are not so dominating as the previously used correction expression implied. The corrected intensities differ at low momenta essentially from the previous estimates. Numerical values for the new multiple-scattering correction are given in the momentum range 1 to 50 GeV/c. The new integral intensity agrees satisfactorily with the measurements of Flint, et. al. (1972), without any normalization. (auth)

30286 ^{26}Al IN CHONDRITES WITH LOW RADIATION AGE. Alekseev, V. A.; Ustinova, G. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Meteoritika; No. 33, 49-50(1974). (In Russian).

The effect of the spatial variation of the galactic cosmic radiation on the evaluation of the cosmic age of meteorites from the absolute concentration of stable isotopes or (in the case of low age) from the unsaturated value of the activity of the long-lived radioisotope ^{26}Al at equal lengths of the meteorite orbit was examined. (tr-auth)

30287 COSMOGENIC ^{39}Ar IN THE METALLIC PHASE OF CHONDRITES AND THEIR PREATMOSPHERIC DIMENSIONS. Lavrukhina, A. K.; Fisenko, A. V.; Kolesnikov, E. M. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Meteoritika; No. 33, 58-60(1974). (In Russian).

A method was described for the evaluation of the preatmospheric radius of chondrites by comparison of the measurement of the activity of the cosmogenic ^{39}Ar in the Fe-Ni phase with the theoretical values for meteorites with different radii R. The results of the calculation of the rate of formation of ^{39}Ar in the Fe-Ni phase of chondrites with R from 10 to 200 cm as a function of the depth of occurrence were reported for two cosmic-ray fluxes, for meteorite orbits in the region of modulation of the galactic cosmic radiation, and outside of this region. The preatmospheric R was evaluated for six chondrites. (tr-auth)

30288 COSMIC HISTORY OF THE METEORITE SIKHOTE-ALIN. Kolesnikov, E. M.; Lavrukhina, A. K.; Levskii, L. K.; Fisenko, A. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Meteoritika; No. 33, 105-108(1974). (In Russian).

The concentration of Ni, Co, Cu, As, Au, Ga, W, and Ir in different examples of the Sikhote-Alin meteorite and in the octahedrite El'ga was measured by the instrumental neutron activation method. All elements except W showed a very homogeneous distribution in the body of the meteorite. (tr-auth)

30289 ATTENUATION OF COSMIC RAY HEAVY NUCLEI FLUXES IN THE UPPER ATMOSPHERE BY FRAGMENTATION. Allkofer, O. C.; Heinrich, W. (Univ., Kiel). Nucl. Phys.; B71: No. 3, 429-438(1974).

Two plastic stacks containing cellulose nitrate as detector material were flown several times with balloons at 40 g cm^{-2} for a total time of 25 hours. From the tracks of 920 heavy nuclei the vertical intensities of the particles of four charge groups ($6 \leq Z \leq 9$, $10 \leq Z \leq 14$, $15 \leq Z \leq 19$, $20 \leq Z \leq 28$) have been derived for atmospheric depths from 40-100 g cm^{-2}. Combining these intensities with other results obtained with emulsions and in counter measurements, the fragmentation probabilities in air have been determined by comparison with the primary spectra. (auth)

Stars

Refer also to abstracts 31125 and 31132.

30290 OCCULTATION RESOLUTION OF SIGMA SCORPII. Nather, R. E. (Univ. of Texas, Austin); Churms, J.; Wild, P. A. T. Publ. Astron. Soc. Pac.; 86: No. 509, 116-124(Feb 1974).

An occultation of the β CMa variable σ Sco by the Moon was observed photoelectrically from the South African Astronomical Observatory at Cape Town and simultaneously from the S. A. A. O. outstation at Sutherland. Both observations show that the star has a companion 2.2 magnitudes fainter than the primary; the two observations combined show that the fainter star is 0.49 distant from the primary in position angle 268°. Visual observations of occultation events extending back to 1860, in which duplicity was observed or suspected, are combined with these observations to derive some information concerning the relative orbit of the fainter star. (auth)

30291 PROBABLE OB STAR MEMBERS IN ELEVEN BERKELEY CLUSTERS. Sanduleak, N. (Case Western Reserve Univ., Cleveland, OH). Publ. Astron. Soc. Pac.; 86: No. 509, 74-75(Feb 1974).

The Setteducati-Weaver catalog of new open star clusters discovered on the Palomar Sky Survey plates was compared recently with the catalogs of OB stars published by the Hamburg and Warner and Swasey Observatories. This resulted in the identification of eleven clusters which appear to contain OB stars and which may thus serve as important additional spiral arm tracers in the galactic longitude range of 75° to 135°. Published photometric studies are available for only two of these clusters. (auth)

30292 SEARCH FOR TECHNETIUM IN THE BA II STAR ξ CAPRICORNI. Boesgaard, A. M.; Fesen, R. A. (Univ. of Hawaii, Honolulu). Publ. Astron. Soc. Pac.; 86: No. 509, 76-77(Feb 1974).

A search for singly ionized technetium (Tc II) in the barium ξ Cap (G5 III) at a dispersion of 3.3 Å mm^{-1} is reported. η Her

(G7 III-IV) and the Sun were used for spectral comparison. No evidence for the presence of Tc II in ξ Cap was found and an upper limit of log N(Tc) $\leq$ 1.6 was derived. (auth)

30293 TECHNETIUM IN UX DRACONIS. Hackos, W. Jr. (Central Michigan Univ., Mount Pleasant). Publ. Astron. Soc. Pac.; 86: No. 509, 78-79(Feb 1974).

Absorption lines of the unstable element technetium are present in the spectrum of the N-type semiregular variable UX Dra. (auth)

30294 CALIBRATION OF UBY PHOTOMETRY. Olson, E. C. (Univ. of Illinois, Urbana). Publ. Astron. Soc. Pac.; 86: No. 509, 80-89(Feb 1974).

Intermediate-band Strömgren color indices (b−y) and (u−b) are calculated using the known photometric sensitivity functions and normalizing with spectrum scanner observations. Colors are calculated for three grids of stellar model atmospheres, and compared to photoelectric observations spanning the B to G spectral range. (auth)

30295 REALITY OF THE HIGH LITHIUM ABUNDANCES IN CARBON STARS. Cohen, J. G. (Univ. of California, Berkeley). Publ. Astron. Soc. Pac.; 86: No. 509, 31-32(Feb 1974).

Because of recent advances in model atmospheres for cool stars, there may be some doubt as to the validity of previous estimates of the Li abundance in the super-Li stars. Through the behavior of the resonance lines of KI, it is shown that these analyses are correct, and that the super-Li stars represent a real abundance peculiarity of Li. (auth)

30296 PHOTOELECTRIC EQUIVALENT WIDTHS OF THE O I λ 7774 LINE AND M_v'S OF SELECTED F SUPERGIANTS. Baker, P. W. (Univ. of California, Santa Cruz). Publ. Astron. Soc. Pac.; 86: No. 509, 33-37(Feb 1974).

Photoelectric scanner measurements of the equivalent width of the O I λ7774 triplet, for 52 F supergiants brighter than m_v = 9.0, are presented. The linear relation between the equivalent width and absolute visual magnitudes found by Osmer (1972) for 10 stars with known distances is confirmed and this calibration is used to find the absolute visual magnitudes of 51 F supergiants. A comparison of the equivalent widths for 17 stars in common with Osmer shows a good agreement, on the average. Stars of class F5 Ib−F9 Ib show a decreasing equivalent width with advancing type, in agreement with spectroscopic evidence. (auth)

30297 LIGHT VARIATIONS OF RX ANDROMEDAE. Szkody, P. (Univ. of Washington, Seattle). Publ. Astron. Soc. Pac.; 86: No. 509, 38-42(Feb 1974).

Short time-resolution photometry of RX And was done over a complete orbital cycle to determine the light variations. No eclipses or periodicity on the order of seconds was detected. Variations of the order of 0.1 to 0.6 magnitude occurred on the order of 3 minutes. Under the assumption that free−free emission from a hot spot is responsible for most of the light in the binary system, the possible changes in the relevant parameters of temperature and electron density are computed to account for the observed variations. (auth)

30298 PHOTOMETRY OF UW ARIETIS AND V600 HERCULIS. Jerzykiewicz, M. Publ. Astron. Soc. Pac.; 86: No. 509, 43-50 (Feb 1974).

Photoelectric observations of UW Ari and V600 Her are presented. It is shown that, contrary to what is reported in the literature, neither UW Ari nor V600 Her is a β Cephei variable. UW Ari is found to be constant in light. The light variation of V600 Her is either erratic or is due to photometric effects of binary motion in an eccentric orbit. (auth)

30299 SPECTRAL TYPES OF THE MEMBERS OF VV CEPHEI SYSTEMS FROM PHOTOMETRIC ANALYSIS. Wawrukiewicz, A. S. (Western Kentucky Univ., Bowling Green); Lee, T. A. Publ. Astron. Soc. Pac.; 86: No. 509, 51-55(Feb 1974).

The photometric data for ten binary systems that have a highly luminous red primary with a less luminous blue companion were analyzed and the spectral types of the member stars determined. Eight of these systems are VV Cephei-type systems. One, α Sco, has a more distant blue companion, while XX Per has a blue companion that is probably too distant to induce emission. It was determined that the blue companion of WY Gem is an intrinsic variable. (auth)

30300 LX PERSEI, AN ECLIPSING BINARY WITH H AND K EMISSION. Weiler, E. J. Publ. Astron. Soc. Pac.; 86: No. 509, 56-58(Feb 1974).

Masses and MK classes are determined for the eclipsing spectroscopic binary LX Per (BD + 47° 0781, 8^m55-9^m55). The system has a period of 8.0 days. The cooler component has strong Ca II emission with the same velocities as its absorption lines and is slightly more massive than the hotter component. LX Per is likely a member of the group of eclipsing binaries with strong H and K emission whose prototype is RS CVn. (auth)

30301 SPECTROSCOPIC OBSERVATIONS OF THE HYADES SPECTROSCOPIC BINARY BD + 24°692. Young, A. (California State Univ., San Diego). Publ. Astron. Soc. Pac.; 86: No. 509, 59-62(Feb 1974).

The star BD + 24°692 is confirmed to be a double-lined spectroscopic binary consisting of two lower main-sequence K stars. Another candidate for a low-mass binary is also given. (auth)

30302 SPECTROSCOPIC ORBIT FOR THE Am ECLIPSING SYSTEM AN ANDROMEDAE. Young, A. (California State Univ., San Diego). Publ. Astron. Soc. Pac.; 86: No. 509, 63-66(Feb 1974).

A new spectroscopic orbit for the eclipsing binary AN And is presented based upon 23 intermediate-dispersion spectrograms. A change in the γ velocity from an earlier orbit is noted and discussed. (auth)

30303 MAGNETIC FIELD OF HR 6870. Jones, T. J.; Wolff, S. C. (Univ. of Hawaii, Honolulu). Publ. Astron. Soc. Pac.; 86: No. 509, 67-69(Feb 1974).

Zeeman spectroscopic observations demonstrate that the peculiar B star HR 6870 has a magnetic field. The measured field strengths range from −260 gauss to −1080 gauss with no reversal of sign. This star is probably a spectroscopic binary, since it appears to show low-amplitude (~1 km sec^{-1}) velocity variations. (auth)

30304 MK SPECTRAL TYPES FOR SOME BRIGHT F STARS. Cowley, A.; Fraquelli, D. (Univ. of Michigan, Ann Arbor). Publ. Astron. Soc. Pac.; 86: No. 509, 70-73(Feb 1974).

MK spectral types are presented for 100 stars previously classified F0. This comprises a portion of a larger project to assign accurate spectral types to the stars in the Bright Star Catalogue. (auth)

30305 OBSERVATIONS OF THE RECENT OUTBURST OF NOVA V1017 SAGITTARII. Vidal, N. V.; Rodgers, A. W. Publ. Astron. Soc. Pac.; 86: No. 509, 26-30(Feb 1974).

Photometric and spectrographic observations of the recent outburst of V1017 Sgr are reported. The B magnitude varied from the 11th to 14th magnitude during the period February to June 1973. The shape and amplitude of the light curve are similar to the light curve observed at the 1901 outburst. Broad emission lines and very weak and vague absorption lines characterize spectra taken at premaximum, maximum, and postmaximum. The spectra and light curve indicate the recent outburst was not a major one. (auth)

30306 PROPERTIES OF MATTER IN NEUTRON STARS. Boerner, G. (Goddard Space Flight Center, Greenbelt, MD). Springer Tracts Mod. Phys.; 69: 1-67(1973).

A qualitative description of the interior of a neutron star is presented, giving attention also to the validity of the "isotropic fluid" approximation. The atmosphere and surface of a neutron star are considered together with aspects concerning nuclear and solid state physics in the crust, the liquid interior, the hyperon core, neutron star models, and pulsar observations. Accretion processes are also investigated, taking into account such topics as the Eddington limit, accretion rates, the death of pulsars, changes of the surface composition of neutron stars by accretion, questions of x-ray emission, and aspects of gamma radiation emission. (IAA)

30307 PROTON SUPERFLUIDITY IN NEUTRON-STAR MATTER. Takatsuka, T. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 5, 1754-1755(Nov 1973).

30308 REPORTS ON ASTRONOMY. De Jager, C. (ed.). International Astronomical Union, Transactions, Volume 15A. Dordrecht, Netherlands; D. Reidel Publishing Company (1973). 744p. (In English and French). $88.65.

Topics discussed include ephemerides; celestial mechanics; positional astronomy; instruments and techniques; solar activity; radiation and structure of the solar atmosphere; observations of comets; planetary and satellite research; studies of the Moon; the rotation of the Earth; positions and motions of minor planets, comets, and satellites; the night airglow; meteors and meteorites; photographic astrometry; stellar photometry; double stars; variable stars; galaxies; stellar spectra; radial velocities; time; the structure and dynamics of the galactic system; interstellar matter and planetary nebulae; stellar composition; the theory of atmospheres; star clusters and associations; radio astronomy; photometric double stars; astrophysical plasmas and magnetohydrodynamics; astronomical observations from outer space; spec-

tral classifications and multiband color indices; cosmology; and high-energy astrophysics. (IAA)

30309 PROBLEMS ON CALIBRATION OF ABSOLUTE MAGNITUDES AND TEMPERATURE OF STARS. Proceedings of the Symposium, Geneva, Switzerland, September 12–15, 1972. Hauck, B. (ed.). IAU Symposium, No. 54. Dordrecht, Netherlands; D. Reidel Publishing Company (1973). 300p. $26.80.

Topics discussed include the determination of absolute magnitudes of stars from trigonometric and statistical parallaxes, the determination of absolute magnitudes from galactic clusters and associations, the calibration of spectroscopic parallaxes, the determination of absolute magnitudes from hydrogen-line photometry, ground-based and extraterrestrial observations of stellar flux, the use of model atmospheres for temperature calibration, stellar temperature scale and bolometric corrections, and the criteria governing the choice of standard stars. (IAA)

30310 PHOTOELECTRIC OBSERVATIONS OF β Lyr IN 1971. Cester, B.; Pucillo, M. (Astronomical Observatory, Trieste, Italy). Astron. Astrophys., Suppl. Ser.; 13: No. 3, 405-414(Mar 1974).

The results of photoelectric observations in UBV and with six interferential filters of β Lyr and of a set of standard (check) stars made during the international campaign in July–August 1971 are given and commented. (auth)

30311 GLOBULAR CLUSTER NGC 4372. Alcaino, G. (Universidad Catolica de Chile, Santiago). Astron. Astrophys., Suppl. Ser.; 13: No. 3, 345-353(Mar 1974).

A UBV photometric investigation of the Southern Globular Cluster NGC 4372 was carried out using the 1 m telescope of Cerro La Silla (ESO) for the photoelectric work, and the 1.5 m telescope of Cerro Tololo (AURA) together with the 1 m telescope of Cerro Las Campanas (CARSO), for the photographic work. Fourteen stars were observed photoelectrically with a limiting apparent magnitude V = 15.88 m. Using this sequence 186 stars were measured photographically. The derived apparent distance modulus is $(m-M)_{app}$ = 15.1 m; the reddening E(B–V) = 0.37 m. The true distance modulus is $(m-M)_0$ = 13.99 m. The distance is 6.28 kpc from the sun, 1.09 kpc from the galactic plane and 8.69 kpc from the galactic center. The giant branch rises 3.1 m above the horizontal branch at $(B-V)_0$ = 1.4 m, characteristic of a metal poor object. (auth)

30312 RADIAL VELOCITIES OF THREE VISUAL BINARIES. Andersen, J. (Univ. of Copenhagen). Astron. Astrophys., Suppl. Ser.; 13: No. 3, 355-357(Mar 1974).

Radial-velocity observations of the primary components of ADS 7967 and ADS 8327 and of both components of IDS 19316N5957 are reported. They confirm that the last of these is an optical pair. (auth)

30313 BINARY SYSTEMS IN STAR CLUSTERS. I. V701 Sco. Leung, K. C. (Univ. of Nebraska, Lincoln). Astron. Astrophys., Suppl. Ser.; 13: No. 3, 315-324(Mar 1974).

The eclipsing binary V701 Sco in the galactic cluster NGC 6383 was observed photoelectrically for eight nights with B, V filters. Complete coverage of the light curves was obtained. The standard Russell and Merrill method of rectification was applied to the light curves. It was found that the rectified depths of the minima were too shallow to allow a definitive solution of the orbital elements. (auth)

30314 LUMINOSITY AND VELOCITY DISTRIBUTION OF HIGH-LUMINOSITY RED STARS. IV. The G-Type Giants. Eggen, O. J. (Mount Stromlo Observatory, Canberra, Australia). Publ. Astron. Soc. Pac.; 86: No. 510, 129-161(Apr 1974).

The G-type giants and subgiants brighter than V_0 = 5.0 m are discussed together with (1) the Hyades group giants, (2) the very young-disk-population cluster M 11, (3) the Wolf 630 group and M 67 in the old-disk population, and (4) the available narrow-band indices which measure surface gravity and CN strength in red-giant stars. Also included are discussions of the luminosity function of young-disk-population giants, the bright members of the Pleiades group, a few possible giant members of the solar group, and color–color relations as a function of luminosity. (auth)

30315 OLDEST DISK STARS. Eggen, O. J. (Mount Stromlo Observatory, Canberra, Australia). Publ. Astron. Soc. Pac.; 86: No. 510, 162-172(Apr 1974).

A summary of some photometric and kinematic data for the oldest disk stars is presented together with a detailed discussion of one of the oldest disk-population groups; the Arcturus group. The slope of the lower main sequence of the old-disk population appears to be a function of the eccentricity of the star's galactic orbit and this phenomenon, together with the apparent lack of stars intermediate between the Hyades and subdwarf sequences, requires understanding before moduli of many old clusters can be regarded as reliable. (auth)

30316 ORBIT OF THE MANGANESE STAR HR 8704. Wolff, R. J. (Univ. of Hawaii, Honolulu). Publ. Astron. Soc. Pac.; 86: No. 510, 173-175(Apr 1974).

Radial velocity measurements from 11 coudé spectrograms were used to derive the orbital elements of this double-line spectroscopic binary. The period is the shortest known for a Mn star, P = 3.42981 d, the masses are $M_1 \sin^3 i = 1.8\ M_\odot$, $M_2 \sin^3 i = 1.5\ M_\odot$, and the luminosity ratio estimated from line strengths is 0.64. Mercury is found in the spectra of both stars, but manganese is definitely present only in the primary. (auth)

30317 SPECTROSCOPIC ORBIT OF THE RADIO STAR b PERSEI. Wolff, S. C.; Wolff, R. J. (Univ. of Hawaii, Honolulu). Publ. Astron. Soc. Pac.; 86: No. 510, 176-178(Apr 1974).

Radial velocities from the nine coudé spectrograms, obtained in September 1973, were used to derive orbital elements for the radio star b Per. (auth)

30318 APSIDAL MOTION IN THE Ap STAR HD 98088. Wolff, S. C. (Univ. of Hawaii, Honolulu). Publ. Astron. Soc. Pac.; 86: No. 510, 179-180(Apr 1974).

New observations of the radial velocity variation of the Ap star HD 98088 were used to show that the period of apsidal motion is at least 700 years. The new observations, combined with earlier ones, were used to derive revised orbital elements. (auth)

30319 POSSIBLE APSIDAL ADVANCE IN HS HERCULIS. Scarfe, C. D.; Barlow, D. J. (Univ. of Victoria, B. C.). Publ. Astron. Soc. Pac.; 86: No. 510, 181-182(Apr 1974).

Times of both minima of HS Her were obtained in the summer of 1973. The results support the proposal of Hall and Hubbard that the orbit is slightly eccentric, but fail to confirm their apsidal period. (auth)

30320 ORBIT OF HR 7694. Dworetsky, M. M. (Carnegie Institution of Washington, DC). Publ. Astron. Soc. Pac.; 86: No. 510, 183-186(Apr 1974).

HR 7694 (HD 191110) was discovered to be a double-lined peculiar star of the Hg type during a search for peculiar objects. The orbit is circular with a period of 9.346 days. The chemical compositions of the two components appear to be different. (auth)

30321 ECLIPSING BINARY SYSTEM KO AQUILAE. Blanco, C.; Cristaldi, S. (Osservatorio Astrofisico, Catania, Italy). Publ. Astron. Soc. Pac.; 86: No. 510, 187-194(Apr 1974).

From observations the period of the KO Aql system was found to be increasing by 3×10^{-8} days per period. V light observations carried out during 1965 showed a significant secondary minimum which become shallower in the 1967 and 1969 observations. The solutions of the light curves obtained were possible only by assuming the primary minimum to be an occultation. The elements of the system were deduced on two hypotheses: (1) The primary component is a main-sequence star and the secondary fills its Roche lobe; (2) the system is in the pre-main-sequence evolutionary phase. (auth)

30322 MULTICOLOR PHOTOMETRY OF ECLIPSING BINARIES WITH UNDERSIZE SUBGIANT SECONDARIES. Barnes, R. C. (Univ. of Missouri, Columbia). Publ. Astron. Soc. Pac.; 86: No. 510, 195-202(Apr 1974).

Strömgren uvby photometric observations of 10 eclipsing binaries thought to contain undersize subgiant secondaries are presented and analyzed. A straightforward analysis of the data indicates that the primaries are 1 to 2 magnitudes brighter than luminosity class V stars and that they do not obey the normal main-sequence mass–luminosity law. However, due to the great sensitivity of mass to the photometrically derived absolute magnitude no firm conclusion was reached. In addition, the data suggest that the actual number of undersize systems may be less than previously thought. (auth)

30323 PHOTOMETRIC OBSERVATIONS OF THE ECLIPSING BINARY LT HERCULIS. Ebbighausen, E. G.; Penegor, G. (Univ. of Oregon, Eugene). Publ. Astron. Soc. Pac.; 86: No. 510, 203-207(Apr 1974).

Photoelectric observations in the B and V spectral regions are given for the interesting eclipsing binary LT Her whose orbital period is close to 26 hours. Remarks are made regarding peculiar features of the light curves and spectrum of the secondary component. (auth)

30324 EMISSION LINES IN THE ORION NEBULA NEAR 8500 A. Danziger, I. J.; Aaronson, M. (Harvard Coll. Observatory, Cambridge, MA). Publ. Astron. Soc. Pac.; 86: No. 510, 208-210(Apr 1974).

An identification of forbidden lines of Cl II at 8579.5 Å and Fe II

at 8617 Å is reported for the Orion Nebula. The unusual behavior of the O I allowed transition at 8556.4 Å is also discussed. (auth)

30325 MEASUREMENT OF ELECTRON TEMPERATURE IN THE ORION NEBULA FROM THE INTENSITY RATIO OF FORBIDDEN TRANSITIONS IN S III. Foukal, P. (Harvard Coll. Observatory, Cambridge, MA). Publ. Astron. Soc. Pac.; 86: No. 510, 211-214(Apr 1974).

The temperature dependence of the intensity ratio R = I(λ9532 + λ9069)/I(λ6312) of three forbidden transitions within the $3p^2$ ground configuration of S III was calculated, and the ratio has been observed in the Orion Nebula. The observed value of R = 56 ± 25% leads to an electron temperature of 9700°K ± 1000°K, after a reasonable reddening correction is made. This value of R is a factor of three higher than that derived from the results of previous observers, which would give $T_e \gtrsim 1.5 \times 10^4$°K even before correction for reddening. Comparison of the theoretical and observed intensity ratios of the lines λ9069 and λ9532 leads to the conclusion that telluric H_2O absorption is not likely to be an explanation of the difference in observed values of R. It is suggested that observations at a spectral resolution too low to separate λ6300 of O I from λ6312 of S III will underestimate the value of R by about the factor noted above. (auth)

30326 NEW SOUTHERN PLANETARY NEBULAE PREVIOUSLY CLASSIFIED AS EMISSION-LINE STARS. Sanduleak, N. (Case Western Reserve Univ., Cleveland). Publ. Astron. Soc. Pac.; 86: No. 510, 215-216(Apr 1974).

Eight objects, originally classified as emission-line stars in earlier Hα-emission-line objective-prism surveys, were reclassified as planetary nebulae as a result of two recently conducted objective-prism surveys of the southern Milky Way which utilized blue-green sensitive plates. (auth)

30327 DISTANCE TO THE HYADES CLUSTER. van Altena, W. F. (Univ. of Chicago). Publ. Astron. Soc. Pac.; 86: No. 510, 217-222(Apr 1974).

The results of numerous investigations of the distance of the Hyades cluster are reviewed. The principal result is that all "secondary" distance indicators yield distance moduli greater than those determined from proper motions. A weighted value of (m−M) = +3.21 ± 0.03 (s.e.) is adopted as the best present distance modulus for the Hyades cluster. (auth)

30328 EXOTIC ASTROPHYSICS. Friedman, H. (Naval Research Lab., Washington, DC). Astronaut. Aeronaut.; 12: No. 4, 20-24(Apr 1974).

Topics discussed include stellar collapse, detection of black holes, giant black holes, and gamma-ray bursts (observations, theoretical proposals, and observational prospects. (WDM)

30329 RELATIVISTIC SPHERES IN POLAR GAUSSIAN COORDINATES. Kuchowicz, B. (Univ. of Warsaw). Postepy Astron.; 21: No. 4, 327-330(1973). (In Polish).

General solutions of the Einstein equations for spherically symmetric matter distributions have been derived already in canonical and isotropic coordinates. An analogous solution is derived for the case of polar Gaussian coordinates. It is a general nonstatic solution, given in terms of integrals over density and pressure, with four arbitrary functions of time. (auth)

30330 SECOND VARIATION AND A GENERALIZATION OF CHANDRASEKHAR'S EQUATION. Kuchowicz, B. (Univ. of Warsaw). Postepy Astron.; 21: No. 4, 323-326(1973). (In Polish).

In a similar way as the first variation of the action integral gives the Einstein equations together with the equations of motion, the second variation of the action integral gives a system of equations describing the stability problem. A general system of such equations for infinitesimal, adiabatic, radial oscillations is derived for the most general metric of spherical symmetry. This system may be reduced to a single equation of the Sturm−Liouville type, which is a generalization of Chandrasekhar's equation that was derived in 1964. (auth)

30331 LINEAR PULSATIONS AND STABILITY OF ROTATING STARS (FOLLOWING SCHUTZ). Abramowicz, M. A. (Astronomical Inst., Warsaw). Postepy Astron.; 21: No. 4, 293-303(1973). (In Polish).

A method based on the variational principle of Seliger and Whitman and yielding the stability criterion for a star made of perfect fluid is described. (auth)

30332 HYDROGEN CONTENT OF YOUNG STELLAR CLUSTERS. I. Methods of Observation and Reduction. Tovmassyan, H. M. (Byurakan Astrophysical Observatory, Erevan). Aust. J. Phys.; 26: No. 6, 829-835(Dec 1973).

Observations of 16 open galactic clusters in their continuum emission and at the neutral hydrogen line have been made with the Parkes 64 m radio telescope in an attempt to determine the total amount of hydrogen gas associated with them. In this, the first of a series of five papers, the observing procedure and the method of data reduction are described. (auth)

30333 PHOTOMETRY OF MINIMA OF U CEPHEI. Bakos, G. A.; Tremko, J. (Astronomical Inst., Skalnate Pleso, Czech.). Bull. Astron. Inst. Czech.; 24: No. 5, 298-305(1973).

The eclipsing binary system U Cephei was observed photoelectrically in the B spectral range during 1968 and 1969. Mean light curves for the deep primary minimum and the shallow secondary minimum are plotted, and it is shown that the system exhibits a general tendency of slowing down at a nonlinear rate. The depth of the minima near the beginning of the total eclipse is variable due to the presence of a luminous cloud trailing the primary star and perhaps due to the secondary component pulsating about its Lagrangian point. (IAA)

30334 IS Cyg X-1 A NEUTRON STAR? Fabian, A. C.; Pringle, J. E.; Whelan, J. A. J. (Cambridge Univ., Eng.). Nature (London); 247: No. 5440, 351-352(8 Feb 1974).

It has been suggested that the source of x radiation from Cygnus X-1 is the unseen secondary which, since it is massive and since it must be compact in order to produce x rays, is likely to be a black hole. Here it is suggested, however, that the source of x-ray emission may be a neutron star in orbit about an early-type relatively unevolved star, both being in orbit about the massive supergiant star DH226868. In this connection it has been noted that about a third of observed binary systems are in fact triple. It is suggested that the secondary consists of two stars—a 1 $M_\odot$ neutron star, which is the source of the x rays, and a 10 $M_\odot$ B1V star. Predictions of this alternative model are discussed. Since the two nondegenerate stars are both early-type that may both have strong enough stellar winds to power the x-ray source. It is concluded that there is no need to involve the existence of black holes to explain the properties of x-ray sources. (UK)

30335 PERIOD OF THE ECLIPSING BINARY TV CASSIOPEIAE. Bakos, G. A.; Tremko, J. (Astronomical Inst., Skalnate Pleso, Czech.). Bull. Astron. Inst. Czech.; 24: No. 5, 305-310(1973).

30336 BLACK HOLE IN ASTROPHYSICS. The Origin of the Concept and its Role. Chandrasekhar, S. (Univ. of Chicago). Contemp. Phys.; 15: No. 1, 1-24(Jan 1974).

The advent of general relativity showed how gravity influences the trajectories of light rays and from this concept the idea of gravitational fields strong enough to contain light became entirely reasonable. The possibility of the occurrence of black holes then rested on whether such intense gravitational fields could occur in nature. The principal astronomical question is whether stars during the course of their evolution attain such highly collapsed states. Since the answer is in the affirmative it is generally considered that black holes must occur in large numbers in the astronomical Universe. It is argued that collapse must be of frequent occurrence in the Galaxy and black holes must be present in numbers comparable to, if not exceeding, those of the pulsars. The evidence from which it has been deduced that Cyg X-1 is a binary system in which one of the components is a black hole is reviewed. The occurrence of neutron stars and black holes in close binary systems is considered. (UK)

30337 HEAVY ION TRANSFER REACTIONS IN NUCLEAR ASTROPHYSICAL PROCESSES. Conlon, T. W. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Nature (London); 247: No. 5439, 268-269(1 Feb 1974).

It is stated that an appraisal of nuclear reactions in heavy ion systems known to be of importance in astrophysical processes indicated that reactions involving transfer of α particles could be significant and should be included in reaction network studies leading to the prediction of stellar abundances. The heavy ion systems of interest are $^{16}O + {}^{16}O$, $^{12}C + {}^{16}O$, and $^{12}C + {}^{12}C$. Recent experimental results showed that in the case of the $^{12}C + {}^{16}O$ system, at energies of astrophysical importance, the channel leading to $^{28}Ne + 2\alpha$, which corresponds to α-particle transfer, is of significant importance, a result that influences predictions of the abundance of ^{20}Ne and that of elements depending on ^{20}Ne for their subsequent formation. The present communication seeks to identify, for the heavy ion systems involved, which reactions are likely to have a non-negligible rate. (UK)

30338 HYDROGEN CONTENT OF YOUNG STELLAR CLUSTERS. II. Clusters NGC2175, 2264, 2353, and 2362. Tovmassyan, H. M.; Shahbazyan, E. T. (Byurakan Astrophysical Observatory, Erevan). Aust. J. Phys.; 26: No. 6, 837-842(Dec 1973).

Measurements of the total amount of gaseous hydrogen associated with the O-type stellar clusters NGC2175, 2264, 2353, and

2362 are reported. For the nebula in which NGC2175 is embedded, a mean electron density of 20 cm^{-3} and a mass of ionized hydrogen of 1400 $M_\odot$ were obtained. For the nebula in which NGC2264 is embedded, a mean electron density of 10 cm^{-3} and a mass of ionized hydrogen of 60 $M_\odot$ (with a possible, though unlikely, additional 40 $M_\odot$ of neutral hydrogen) were obtained. No hydrogen in association with NGC2353 or 2362 was detected. (auth)

30339 HYDROGEN CONTENT OF YOUNG STELLAR CLUSTERS. V. Clusters NGC6604, 6611, and 6823. Tovmassyan, H. M.; Neressian, S. E. (Byurakan Astrophysical Observatory, Erevan). Aust. J. Phys.; 26: No. 6, 861-866(Dec 1973).

Measurements of the total amount of hydrogen gas associated with the O-type clusters NGC 6604, 6611, and 6823 are reported. Only a small part of the large visible nebula in which NGC 6604 appears to be embedded is associated with the cluster. The small ionized nebula associated with NGC6604 has a mass of ~600 $M_\odot$ and is part of a larger neutral cloud. The mass of the ionized nebula associated with NGC6611 is ~5000 $M_\odot$, while a neutral hydrogen shell with a total mass of ~10^5 $M_\odot$ probably surrounds the ionized nebula. The cluster NGC6823 is embedded in a bright nebula of mass ~1800 $M_\odot$. A neutral hydrogen shell of mass ~2000 $M_\odot$ surrounds the ionized nebula, so that the total mass of hydrogen associated with NGC6823 is ~4000 $M_\odot$. (auth)

30340 HYDROGEN CONTENT OF YOUNG STELLAR CLUSTERS. IV. Clusters NGC6383, 6514, and 6531. Tovmassyan, H. M.; Nersessyan, S. E.; Shahbazyan, E. T. (Byurakan Astrophysical Observatory, Erevan). Aust. J. Phys.; 26: No. 6, 853-860(Dec 1973).

The total amount of hydrogen associated with the young stellar clusters NGC6231, 6383, 6514, and 6531 has been obtained from observations in the continuum at 1410 MHz and in the hydrogen-line emission. NGC 6231 contains in its southern part a cloud of neutral hydrogen atoms of density 6 cm^{-3} and total mass 100 $M_\odot$ and in its northern part a small ionized cloud of the same density and a mass of ~50 $M_\odot$. NGC6383 is embedded in a large neutral hydrogen complex, of which a small part of mass ~450 $M_\odot$ is ionized. The Trifid nebula is ionized by a single O7-type star at nearly twice the accepted distance of NGC6514 and the existence of NGC6514 as a physical cluster appears to be doubtful. The mass of the ionization-bounded Trifid nebula is nearly 5000 $M_\odot$. Neither neutral nor ionized hydrogen was found in association with NGC6531. (auth)

30341 HYDROGEN CONTENT OF YOUNG STELLAR CLUSTERS. III. Clusters NGC3293, 6167, 6193, 6200, and 6204. Tovmassyan, H. M.; Shahbazyan, E. T.; Nersessyan, S. E. (Byurakan Astrophysical Observatory, Erevan). Aust. J. Phys.; 26: No. 6, 843-851(Dec 1973).

The total amount of hydrogen associated with the O-type clusters NGC3293, 6193, and 6204 and the suspected clusters NGC6167 and 6200 has been measured. Neither neutral nor ionized hydrogen was found to be associated with NGC3293 and the visible nebula in this region is most likely associated with a single O7-type star, which does not appear to belong to the cluster, while an irregular expanding shell of neutral hydrogen probably surrounds the ionized nebula. The mass of hydrogen associated with NGC6193 does not exceed 500 $M_\odot$. Neither neutral nor ionized hydrogen was detected at the position of NGC6204. The features detected by hydrogen-line observations at the positions of suspected clusters NGC6167 and 6200 provide evidence that both visual groupings may be real clusters. The amount of neutral hydrogen probably connected with NGC6167 is ~1000 $M_\odot$. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 30306.

30342 (COO-3071-51) ANALYTIC PULSAR MODELS. Adams, R. C.; Cohen, J. M.; Adler, R. J.; Sheffield, C. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 16 Jan 1974. 12p. Dep. NTIS $4.00.

An analytic and fully general relativistic solution to Einstein's field equations is given. This analytic model of a slowly rotating neutron star can describe differentially as well as uniformly rotating stars. (auth)

30343 (IC-74-6) MODELS OF EXTRAGALACTIC RADIO SOURCES WITH A CONTINUOUS ENERGY SUPPLY FROM A CENTRAL OBJECT. Scheuer, P. A. G. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1974. 45p. Dep. NTIS (U. S. Sales Only) $5.25.

The dynamics of radio-source models in which energy is carried from a nucleus to the radio components by a relativistic beam are considered. Only a small fraction of the energy supply can be radiated away from the tip of the beam, and the rest lingers on in a cavity surrounding the beam. For the dynamical development it is not of great importance whether the "beam" consists of strong electromagnetic waves or of fast particles with or without magnetic fields, or even if the energy is supplied from a moving massive object instead of the tip of a beam. If the energy in the cavity contains both fast electrons and magnetic fields, then the cavity rather than the tip of the beam is likely to be the site for the greater part of the radio emission. When the lateral expansion of the cavity becomes subsonic, the outer parts of the cavity swell at the expense of the parts nearest the massive nucleus, where the thermal gas pressure is higher. (auth)

30344 INFRARED EMISSION FROM H II REGIONS. Wynn-Williams, C. G. (California Inst. of Tech., Pasadena); Becklin, E. E. Publ. Astron. Soc. Pac.; 86: No. 509, 5-25(Feb 1974).

This review covers observations from 1.5μ to 1.5 mm. Observational techniques, surveys and sources, and observational results are discussed. (WDM)

30345 COMMENTS ON INNER SUPERFLUID AND INFORMATION FROM PULSAR GLITCHES. Takatsuka, T. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 5, 1755-1757 (Nov 1973).

30346 CIRCUMSTELLAR MATTER IN THE ACCRETION MODEL OF COSMIC X-RAY SOURCES. Hayakawa, S. (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 50: No. 2, 459-471 (Aug 1973).

Matter accretion onto compact stars has been considered as a likely process of x-ray emission from stellar x-ray sources. The accreting matter forms a circumstellar envelope that absorbs a part of x rays emitted from the central star. The ionization equilibrium due to the photoionization by x rays and the recombination with electrons is calculated, and the optical depth for x-ray absorption is obtained as a function of the mass and radius of the central star, the absolute luminosity, and the spectrum of x rays. The K-absorption of oxygen and the L-absorption of iron are found to be responsible for the reduction of the x-ray intensity in the energy range 0.9 to 3 keV. This is not in favor of the interpretation of Sco X-1 in terms of the accretion model, whereas the circumstellar absorption explains the x-ray spectrum of Cen X-3, thus further supporting the model that Cen X-3 is a neutron star belonging to a close binary system. (auth)

30347 BLACK HOLES: THE OUTSIDE STORY. Stewart, J.; Walker, M. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Springer Tracts Mod. Phys.; 69: 69-115(1973).

A number of properties of the space–time region outside a black hole are discussed within the context of general relativity. The model chosen to describe this region froms a part of Kerr's solution (1963) of Einstein's vacuum gravitational field equations. Aspects of the coordinate system and tetrads are considered, taking into account the Boyer–Lindquist coordinate system, the Kerr field, locally nonrotating frames, and the ergosphere. Test particle trajectories in the Kerr field are investigated together with tidal forces. Perturbations of the Kerr field are also discussed, giving attention to gauge invariance and the decoupling of the perturbation equations. (IAA)

30348 POLARIZATION OF SUPERNOVA REMNANTS AT CENTIMETER WAVELENGTHS. Velusamy, T. College Park, MD; Univ. of Maryland (1973). 200p. University Microfilms Order No. 74-269.

Thesis (Ph. D.).

A survey of the distributions of intensity and linear polarization at 11 cm in supernova remnants in the northern sky was made using the 300-ft telescope of the National Radio Astronomy Observatory. Twenty-two supernova remnants were mapped in total intensity only. Additional observations of the distributions of intensity and polarization at 6 and 2.8 cm were made with the 140-ft telescope in order to investigate the Faraday rotation effects in some of the supernova remnants. The angular resolutions of the present observations at 11, 6, and 2.8 cm were 5.5', 6', and 3' respectively. (WDM)

30349 SPHERES WITH THREE DENSITY DISTRIBUTIONS AND REDSHIFT FROM STELLAR BODIES. Durgapal, M. C.; Gehlot, G. L. (Jodhpur Univ., India). Indian J. Radio Space Phys.; 1: No. 3, 195-197(1972).

Exact internal solutions were found in a massive sphere with two density distributions surrounded by matter of very low density. The presence of external matter of very low density changes the gravitational potential to such an extent that the redshift obtained is as high as z = 3. Further, the results ob-

tained were applied to quasars, explaining the broadening and the large redshifts of the spectral lines. (Indian Sci. Abstr.)

30350 FURTHER 408 MHz SURVEY OF THE NORTHERN SKY. Haslam, C. G. T.; Wilson, W. E.; Graham, D. A.; Hunt, G. C. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys., Suppl. Ser.; 13: No. 3, 359-394(Mar 1974).

The 100 m radiotelescope of the Max Planck Institut für Radioastronomie was used to make a fully sampled survey at 408 MHz of part of the northern sky. The region covered was chosen to complement an earlier survey made at Jodrell Bank (Haslam et al. 1970). The area covered is $12h < R.A. < 04h$, $-8° < Dec. < +48°$. The angular resolution of the survey was 37 arc minutes. Two independent surveys were made of the area and the rms temperature difference in the colder regions was 1.7 K. The temperature scale and zero level were determined from comparison with other surveys and had errors of 10% and ±3 K respectively. Contour maps are presented in both equatorial and new galactic coordinates. (auth)

30351 CSIRO, DIVISION OF RADIOPHYSICS, RESEARCH ACTIVITIES, 1973. Epping, Australia; Commonwealth Scientific and Industrial Research Organization (1973). 37p.

Descriptions are given of a number of astronomical and instrumental topics currently being investigated by the Division. An account is also given of support with the Parkes telescope of the NASA manned lunar landings Apollo 11 and 17. A brief account is given on work in radio navigation. (WDM)

30352 RADIO SPECTRA FOR THREE QSOs. Murdoch, H. S. (Univ. of Sydney). Nature (London); 247: No. 5441, 443-444(15 Feb 1974).

Radio spectra are shown for the following sources: 1548 + 114 (4C 1150), which is one of two quasars separated by about 5 arcs that have been suggested as possibly associated despite widely different redshifts; 1331 + 170, which is a very luminous QSO with a rich absorption spectrum; and 1442 + 101 (OQ 172), which has the highest known redshift. These spectra are discussed. (UK)

30353 HELIUM ABUNDANCES IN FOUR GALACTIC HII REGIONS FROM RADIO RECOMBINATION LINE OBSERVATIONS. Huchtmeier, W. K.; Batchelor, R. A. (CSIRO, Epping, Australia). Aust. J. Phys.; 26: No. 6, 901-902(Dec 1973).

Helium abundances in four galactic HII regions were derived from radio recombination line observations. (auth)

30354 STRUCTURES OF SOME EXTRAGALACTIC SOURCES AT 5000 MHz. Wall, J. V.; Cole, D. J. (CSIRO, Epping, Aust. J. Phys.; 26: No. 6, 881-896(Dec 1973).

The large-scale structures of 30 extragalactic sources were investigated using the Parkes 64 m telescope at 5000 MHz. Contour maps are presented for the resolved sources and comparisons are made with observations at lower frequencies. (auth)

30355 SPECTRA FOR 107 RADIO SOURCES SELECTED AT 408 MHz. Murdoch, H. S.; Hoskins, D. G. (Univ. of Sydney). Aust. J. Phys.; 26: No. 6, 867-880(Dec 1973).

Radio spectra are presented for 107 sources which have previously been examined for optical identifications based on 408 MHz positions obtained with the Molonglo cross. Flux density measurements are given at five frequencies from 318 to 2695 MHz. The relationship between spectrum and optical identification is discussed. For sources with peaked, flat, or complex spectra the identification rate with QSO candidates is very high. For the remaining sources, no significant difference between the spectral index distribution of QSOs and galaxies is found. (auth)

30356 NEAR INFRARED OBSERVATIONS OF CYGNUS X-3. Bahcall, J. N. (Princeton Univ., NJ); Bahcall, N. A. Nature (London); 247: No. 5441, 446-447(15 Feb 1974).

The results of observations made at wavelengths of $\sim$0.85 μm in July and August 1973 are reported, using a magnetically focussed image tube with a photocathode sensitive in the near infrared. This equipment was somewhat more sensitive in the near infrared than previous systems employed and the coverage was much more extensive. No object was detected at the position of Cygnus X-3. (UK)

Solar Phenomena

Refer also to abstracts 30351, 30443, and 30450.

30357 (AD-762485) ESTIMATING THE FLARE-PRODUCTION POTENTIAL OF SOLAR ACTIVE REGIONS FROM ANALYSIS OF REAL-TIME MAGNETIC FIELD DATA. Rust, D. M. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 17 Apr 1973. 29p. (AFCRL-TR-73-221; AFCRL-ERP-440). NTIS $3.50.

A magnetograph at the Sacramento Peak Observatory is being used on a daily basis to record the magnetic fields in solar active regions. Contour maps of the line-of-sight component of the field are available to the observers and to the flare prediction groups at NOAA and AWS within an hour after observation. The contour maps reveal many details of both weak and strong magnetic fields that are closely associated with large and small flares. Through the use of several examples, empirical rules for estimating flare likelihood are developed. Analysis of the magnetograms shows that flares are probably associated with X-type or Y-type neutral points in the magnetic fields of the solar chromosphere or lower corona. (GRA)

30358 (AD-763756) RELATIVISTIC ELECTRON EVENTS IN INTERPLANETARY SPACE. Simnett, G. M. (California Univ., Riverside (USA)). Jul 1973. Contract N00014-69-A-0200-5001. 123p. (IGPP-UCR-73-12). NTIS $3.00.

The review is concerned with relativistic electron events observed in interplanetary space. The different types of events are identified and illustrated. The relationships between solar x-ray and radio emissions and relativistic electrons are examined, and the relevance of the observations to solar flare acceleration models is discussed. A statistical analysis of electron spectra, the electron/proton ratio, and propagation from the flare site to the Earth is presented. A model is outlined which can account for the release of electrons from the Sun in a manner consistent with observations of energetic solar particles and electromagnetic solar radiation. (GRA)

30359 (SLA-74-139) SAFETY PLAN FOR AUSTRALIAN ECLIPSE OPERATION IN JUNE 1974. Smelser, J. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. 160p. Dep. NTIS $11.00.

During the solar eclipse of June 20, 1974, in western Australia, a team of scientists and engineers from the United States plan to launch a rocket-borne solar physics experiment near Lancelin, north of Perth. The purpose is to study the coronal temperature distribution by observing the Lyman-alpha line width, in an investigation that can be usefully conducted above the Earth's atmosphere only during a total solar eclipse. This report details the plans for the project. (auth)

30360 LECTURES ON SPACE PHYSICS. II. Sun and Interplanetary Medium, Relativistic Astrophysics. Bruzek, A.; Pilkuhn, H. (eds.). Duesseldorf; Bertelsmann Universitaetsverlag (1973). 347p. DM 30,--.

From Sept. 4 to 24, 1972, the German Physical Society arranged four courses on space physics at Titisee, Black Forest. The courses were organized primarily for students and nonspecialists in the field. This volume represents an outgrowth of the lecture notes on the Sun and interplanetary medium and relativistic astrophysics. (WDM)

30361 PROFILE AND POLARIZATION OF THE CORONAL Lα LINE. Beckers, J. M.; Chipman, E. (Sacramento Peak Observatory, Sunspot, NM). Solar Phys.; 34: No. 1, 151-161(Jan 1974).

The profile and polarization of the Lα line in the solar corona were calculated. Coronal temperature variation, solar wind, and other nonthermal motions were taken into account. Because of the relatively low atomic weight of hydrogen the profile of the Lα line is a sensitive indicator of the coronal temperature. The line polarization contains relatively little information except for strong magnetic fields (>70 G). (auth)

30362 MEASUREMENT OF THE X-RAY EMISSION OF THE SOLAR ATMOSPHERE DURING A PERIOD OF LOW ACTIVITY. Wolff, R. S. (Columbia Univ., New York). Solar Phys.; 34: No. 1, 163-172(Jan 1974).

A large-area high-sensitivity x-ray spectrometer was constructed and used to measure the 1.8 to 5.3 Å x-ray emission of the Sun under quiescent conditions. The instrument utilizes Bragg reflection from mosaic graphite crystals. The data indicate that the x-ray emission can best be accounted for by a multitemperature model of the solar atmosphere in which both the overall corona and active regions contribute to the x-ray spectrum. Theoretical calculations of the x-ray flux of a hot, optically thin plasma were used to estimate the solar conditions at the time when the measurements were made. (auth)

30363 IDENTIFICATION OF Fe IX AND Ni XI IN THE SOLAR CORONA. Svensson, L. A.; Ekberg, J. O.; Edlen, B. (Univ. of Lund, Sweden). Solar Phys.; 34: No. 1, 173-179(Jan 1974).

The levels of the configuration $3s^23p^53d$ of Fe IX were experi-

mentally determined from their combinations with $3s3p^6 3d^2D$, ^1D in the region 300 to 400 Å. Wavelengths can be accurately predicted for all transitions within $3s^2 3p^5 3d$, and eight of these can be identified with coronal lines from 2042 to 4585 Å. Also, identifications of solar lines from 171 to 245 Å with electric-dipole and magnetic-quadrupole transitions to the ground state, $3s^2 3p^6\ ^1S$, are confirmed and extended. Solar identifications with corresponding transitions in Ni XI, both within $3s^2 3p^5 3d$ and to the ground state, are proposed on the basis of a short extrapolation. (auth)

30364 DETERMINATION OF CORONAL TEMPERATURE FROM THE DECAY OF TYPE III RADIO BURSTS. Riddle, A. C. (Univ. of Colorado, Boulder). Solar Phys.; 34: No. 1, 181-184 (Jan 1974).

Assumptions inherent in the determination of coronal temperature from the decay rate of Type III radio bursts are examined. It is suggested that no reliable temperature estimates can yet be made. (auth)

30365 FINE STRUCTURE OF A SOLAR ACTIVE REGION AT 3.7 AND 11.1 CM WAVELENGTHS. Kundu, M. R.; Becker, R. H.; Velusamy, T. (Univ. of Maryland, College Park). Solar Phys.; 34: No. 1, 185-188(Jan 1974).

The three-element interferometer of the National Radio Astronomy Observatory was used to observe the Sun at 3.7 and 11.1 cm wavelengths during the period June 5 to 9, 1973. The baselines of the interferometer were 900, 1800, and 2700 meters, with maximum angular resolution of 3″ at 3.7 and 9″ at 11.1 cm wavelengths. The objective of the observing program was to look for the Sun's fine structure at the limb, in active regions, and in flare-associated burst sources. The results of observations of fine structure in an active region located at N 14 W19 on June 8 are presented. (WDM)

30366 COUPLING OF MICROWAVES AT A SELECTED SOLAR ACTIVE CENTER. Scalise, E. Jr.; Kaufmann, P. (Univ., Mackenzie, Sao Paulo, Brazil). Solar Phys.; 34: No. 1, 189-191 (Jan 1974).

The presence of an intense S-component associated with the McMath plage 12094 nearly alone in the southern solar hemisphere in October–November 1972, provided a clear example of polarization sense reversal. The measurements were performed with a 7 GHz polarimeter, and the evolution in flux and percent of circular polarization of the S-component contribution is shown, as well as of the radio bursts that occurred in it, identified after flare data (NOAA, 1972). (WDM)

30367 THEORETICAL CHROMOSPHERIC FLARE SPECTRA. I. Hydrogen Equilibrium for the Kinematic Flare-Shock Model of Nakagawa et al. (1973). Canfield, R. C. (Sacramento Peak Observatory, Sunspot, NM); Athay, R. G. Solar Phys.; 34: No. 1, 193-206(Jan 1974).

The equations of radiative transfer and statistical equilibrium are solved simultaneously for a model hydrogen atom including Lyman-α, Lyman-β, Balmer-α, and the Lyman, Balmer, and Paschen continua. The model atmospheres are the results of Nakagawa et al. (1973) for a kinematic model of the chromospheric solar flare. It is found that the models adequately predict the total intensity of Bα, its wing broadening, the presence of a red-shifted wing, the maximum electron density, the total line-of-sight second-level population, and the narrowness in height of the Bα emitting region. The profile of Bα is strongly self-reversed, however, and agrees with observations only in the presence of 40 to 70 km s^{-1} macroturbulent motion. It is found that Nakagawa et al. (1973) seriously overestimate the radiative loss function, which will have a large effect on their models. Proper radiative loss calculations must be included in any physically realistic model. (auth)

30368 METHOD TO DETERMINE THE EFFECTIVE EXTENSION, VISIBILITY OF THE BALMER CONTINUUM, AND THE EFFECTIVE MASS IN SOLAR FLARES. Guseinov, R. E.; Tzirulnik, L. B.; Babayev, A. H. (Astrophysical Observatory, Azerbaijan, USSR). Solar Phys.; 34: No. 1, 207-215(Jan 1974).

A method to determine the emission measure and hence the effective extension of solar flares is described. The conditions for the Balmer continuum to be visible in disk flares are also considered. The concept of the effective mass is introduced and it is shown that this mass is a little less than that of a plasma filling the whole spectroscopic volume and including thin and dense filaments and the intervals between them as well. In this connection it is necessary to have high-energy electron fluxes. It is assumed that these electrons maintain a high temperature in the interval volume; being a source of powerful x rays, such hot intervals can heat cool filaments and they in their turn reradiate in the visible and ultraviolet regions of the flare spectrum. Taking one flare as an example, curves of the emission measure, effective mass, and numbers of hydrogen atoms in the second quantum state versus time are given. These curves agree qualitatively with the light curve characteristics for most of the flares. (auth)

30369 FINE STRUCTURE OF A SOLAR FLARE REGION AT 3.7 AND 11.1 CM WAVELENGTHS. Kundu, M. R.; Velusamy, T.; Becker, R. H. (Univ. of Maryland, College Park). Solar Phys.; 34: No. 1, 217-222(Jan 1974).

On June 9, 1973, a flare associated burst was observed with the NRAO 3-element interferometer at 3.7 and 11.1 cm wavelength. The burst was of "gradual rise and fall" type. Comparing the fringe amplitudes at 3.7 cm to the visibility computed for model flare regions it was found that the precursor data are best fitted by a region of 3″ in size while at the time of the peak, the flare appears to have a size of 2″. During the post-maximum phase a size of 5″ is the best estimate. Similar computations have been done for 11.1 cm data. The peak brightness temperatures are 1.2×10^9 K and 1.65×10^8 K at 3.7 and 11.1 cm respectively. Such high temperatures would imply that a significant fraction of the burst radiation has a nonthermal origin. (auth)

30370 EFFECT OF SOLAR CORONA CONDITIONS ON FLARE PARTICLE PROPAGATION. Cherki, G. (CEN, Saclay, France); Mercier, J. P.; Raviart, A.; Treguer, L.; Maccagni, D.; Perotti, F.; Villa, G. Solar Phys.; 34: No. 1, 223-229(Jan 1974).

Data on high-energy electrons and protons in different energy windows are analyzed and compared for two solar flares which occurred at 37 W solar longitude on February 25, 1969 and March 29, 1970. While the data for the first of these flares can be interpreted in the framework of a diffusion model with suitable values of the parallel diffusion coefficient, in order to explain the time behavior of the different particles after the second event, one is led to suppose that the coronal magnetic fields are such that particles of different rigidity are ejected at different longitudes and that there is no good magnetic connection of the Earth with the flare region. (auth)

30371 INFLUENCE OF NONUNIFORM SOLAR WIND EXPANSION ON THE ANGULAR MOMENTUM LOSS FROM THE SUN. Priest, E. R.; Pneuman, G. W. (High Altitude Observatory, Boulder, CO). Solar Phys.; 34: No. 1, 231-241(Jan 1974).

The influence on the rate of angular momentum loss from the Sun of magnetic geometries which are not spherically symmetric is estimated. Departures from spherical symmetry are expected to influence significantly the loss rate by two effects—the presence of closed magnetic field regions with no loss and also the variability in the radial distance to the Alfvénic point, as stressed by Mestel (1968). The loss rate is calculated for an MHD solar-wind model with a solar magnetic field whose normal component at the surface is that of a north–south dipole. In contrast to Mestel's work, where the field was assumed dipolar within a certain surface and radial outside, the coupling between the solar wind and magnetic field is here taken into account exactly. For equivalent boundary conditions at the surface, the resulting field configuration yields an angular momentum loss rate which is only 15% of that for the monopole field normally used in angular momentum loss estimates. If, instead of equating boundary conditions at the Sun, one equates the two losses at the equator to that observed at 1 AU by spacecraft, then the ratio of the total loss for the distended dipole to that for the monopole is about 40%. (auth)

30372 BULK VELOCITY OF THE SOLAR WIND α-PARTICLES. Moreno, G.; Palmiotto, F. (CNR, Rome). Solar Phys.; 34: No. 1, 243-245(Jan 1974).

The reasons for the discrepancy existing between the HEOS-1 and Explorer-34 findings on the bulk velocity of the solar-wind α particles were investigated. (WDM)

30373 SOLAR-WIND DIRECTION FROM HEOS 1 AND EXPLORER 33 SATELLITES. Egidi, A.; Signorini, C. (CNR, Frascati, Italy). Solar Phys.; 34: No. 1, 247-251(Jan 1974).

A description is given of the analysis of the solar-wind angular data from the satellite HEOS 1 and a comparison is made with the data obtained by Explorer 33, in the period of time from January 1967 to April 1970. The observed flow direction shows a temporal behavior which suggests the possibility of a long period regular variation. (auth)

30374 SELECTIVE DIFFRACTION WITH POSSIBLE APPLICATION TO SOLAR RESEARCH. Oehman, Y. (Stockholm Observatory). Solar Phys.; 34: No. 1, 253-258(Jan 1974).

The writer describes diffraction phenomena in transmission gratings made as strips of alternating color. He discusses diffraction in slits formed in semitransparent material including liquid or gaseous layers and particularly when line- and band-absorption are present. He suggests that atmospheric seeing should be influenced by selective diffraction in telluric lines. He also

discusses possible seeing effects in the solar atmosphere and prominences and hints at the possibility that irregular or semi-regular selective diffraction may appear in the deep layers of sunspots possibly contributing to the scattering of light. (auth)

30375 RIGID AND DIFFERENTIAL ROTATION OF THE SOLAR CORONA. Antonucci, E.; Svalgaard, L. (Stanford Univ., CA). Solar Phys.; 34: No. 1, 3-10(Jan 1974).

The rotation of the solar corona has been studied using recurrence properties of the green coronal line (5303 Å) for the interval 1947–1970. Short-lived coronal activity is found to show the same differential rotation as short-lived photospheric magnetic field features. Long-lived recurrences show rigid rotation in the latitude interval ±57.5°. It is proposed that at least part of the variability of rotational properties of the solar atmosphere may be understood as a consequence of coexistence of differential and rigid solar rotation. (auth)

30376 DIFFERENTIAL ROTATION. Koehler, H. (Univ., Goettingen, Ger.). Solar Phys.; 34: No. 1, 11-14(Jan 1974).

In a first order approximation the influence of meridional circulations in a spherical shell on the radial dependence of the angular velocity is studied. Due to stationariness the flux of angular momentum which is transported through any sphere by the circulations must be cancelled by the flux of angular momentum due to turbulent friction. If the circulation goes equatorward at the outer surface the law of rotation must be such that angular momentum is transported in outward direction through the sphere. (auth)

30377 REMARKS CONCERNING WARD'S THE LATITUDINAL MOTION OF SUNSPOTS AND SOLAR MERIDIONAL CIRCULATIONS. Tuominen, J. (Univ. of Helsinki). Solar Phys.; 34: No. 1, 15-16(Jan 1974).

Investigations based on independent observational materials and carried out by different authors show that sunspot groups display a latitudinal drift curve, the shape of which depends on phase in the solar cycle. Ward has tried to disprove this. His conclusions are based on ignorance of work done previously and on a mathematical misunderstanding. (auth)

30378 PRELIMINARY THEORETICAL LINE-BLANKETED MODEL SOLAR PHOTOSPHERE. Kurucz, R. L. (Harvard Coll. Observatory, Cambridge, MA). Solar Phys.; 34: No. 1, 17-23 (Jan 1974).

A preliminary theoretical solar model is presented that produces closer agreement with observation than has been heretofore possible. The qualitative advantages and shortcomings of this model are discussed and projected improvements are outlined. (auth)

30379 POSSIBILITY OF DETECTING ABUNDANCE INHOMOGENEITIES RESULTING FROM SPALLATION REACTIONS IN THE SOLAR PHOTOSPHERE. Hultqvist, L. (Stockholm Observatory). Solar Phys.; 34: No. 1, 25-32(Jan 1974).

The possibility of detecting abundance inhomogeneities in the photosphere of the Sun is discussed. These inhomogeneities are postulated to be a result of nuclear reactions caused by high-energy protons from solar flares. From present knowledge of flares and of nuclear reaction cross sections it is found that temporary inhomogeneities in Li-abundance of spectroscopically detectable amounts should not be excluded. Preliminary observations have given negative results. (auth)

30380 SOLAR BISMUTH CONTENT. Hauge, O. (Univ. of Oslo). Solar Phys.; 34: No. 1, 33-35(Jan 1974).

The photospheric absorption spectrum around 4722 A was studied in an attempt to improve the abundance limit of bismuth. An abundance of log $\epsilon \leq 1.9$ is derived. (WDM)

30381 FORMATION OF Mg I 4571 A IN THE SOLAR ATMOSPHERE. IV. Empirical vs Synthetic Analyses. Altrock, R. C. (Sacramento Peak Observatory, Sunspot, NM). Solar Phys.; 34: No. 1, 37-56(Jan 1974).

A comparison is made of synthetic and empirical analyses for the 4571 Å line of Mg I. First, several different inversion techniques are applied to synthetic line profiles. The results show that at least some of these techniques are able to correctly reproduce the input atmosphere to a reasonable degree. Secondly, these same techniques are applied to equivalent observational data. In this case some of the techniques yield results that can be shown to be of comparable quality to the synthetic analysis. It is concluded that although the synthetic method is the best method to use in analyzing observations, some of the simpler empirical methods produce acceptable results in specified restricted cases. (auth)

30382 NON-LTE PROFILES OF THE Al I AUTOIONIZATION LINES. Finn, G. D.; Jefferies, J. T. (Univ. of Hawaii, Honolulu). Solar Phys.; 34: No. 1, 57-75(Jan 1974).

A non-LTE formulation is given for the transfer of radiation in the autoionizing lines of neutral aluminum at λ1932 and λ1936 through both the Bilderberg and Harvard–Smithsonian model atmospheres. Numerical solutions for the common source function of these lines and their theoretical line profiles are calculated and compared with the corresponding LTE profiles. Results show that the non-LTE profiles provide a better match with the observations. They also indicate that the continuous opacity of the standard solar models should be increased in this wavelength region if the center–limb variations of observed and theoretical profiles of these lines are to be in reasonable agreement. (auth)

30383 LINE BROADENING CALCULATIONS FOR SOME INFRARED SOLAR FRAUNHOFER LINES. Deridder, G.; van Rensbergen, W. (Vrije Univ., Brussels). Solar Phys.; 34: No. 1, 77-90(Jan 1974).

Theoretically calculated damping constants for the solar atmosphere at different optical depths are compared with empirical values for three infrared multiplets of C I, O I, and Si I, respectively. A test-calculation was also performed for the NaD-doublet broadened by a gas of He particles, for which many theoretical and experimental values are known. In the case of neutral perturbers (H and He) it was assumed that the interatomic potential was not a Van der Waals potential, but that a Smirnov–Roueff potential was the main cause of the line broadening. The latter description produces an enhancement of $(\gamma_H + \gamma_{H_e})$ with somewhat more than 20% in comparison with the pure Van der Waals assumption. Colliding electrons turn out to give a significant contribution γ_e to the line broadening, especially towards the center of the solar disk (increasing values of the optical depth τ_0). Using the Harvard Smithsonian Reference Atmosphere, assuming that the line broadening was caused almost solely by Van der Waals interaction, and adopting abundance values A of Müller (1966), De Jager and Neven (1970) stated that the empirical values of $A\gamma$ were systematically larger than the theoretical ones, with factors ranging from 1.4 to 4.3. Using the same values for the abundance and the same model atmosphere the same discrepancy was established, but now with a factor ranging only from 0.8 (theoretical value somewhat higher than the empirical one) to 3.1. The discrepancy in the case of the C I multiplet (10700 Å) is almost completely removed. The calculations show further a decrement of γ with decreasing optical depth. (auth)

30384 INFLUENCE OF A PHOTOSPHERIC SPECTRUM OF TURBULENCE ON THE PROFILES OF WEAK FRAUNHOFER LINES. de Jager, C. (Astronomical Inst., Utrecht). Solar Phys.; 34: No. 1, 91-103(Jan 1974).

It is assumed that the motion field in the solar photosphere is described by a spectrum of turbulence, defined by suitably chosen parameters. For various values of the spectral parameters average (i.e., averaged over a sufficiently large part of the photosphere) profiles of weak Fraunhofer lines were computed. The resulting profiles which represent the distribution function of line-of-sight velocity components as modified by the transfer of radiation through the atmosphere, are thereupon still broadened by a function representing the influence of the distribution function of the granulation cell sizes. The resulting functions should be compared with the distribution function of line-of-sight velocity components as derived from observations, in order to arrive at an observational derivation of the parameters of the photospheric spectrum of turbulence. (auth)

30385 COMPARISON OF EUV SPECTROHELIOGRAMS AND PHOTOSPHERIC MAGNETOGRAMS. Gurman, J. B. (Harvard Coll. Observatory, Cambridge, MA); Harvey, J. W. Solar Phys.; 34: No. 1, 105-111(Jan 1974).

A comparison of euv data from the Harvard College Observatory experiment on OSO-6 with photospheric mangetograms from Kitt Peak National Observatory indicates a bipartite relationship between values of the longitudinal field strength B and Mg X intensity I averaged over square areas $35'' \times 35''$: in quiet regions $|B| \sim I^k$, where $0.0 \leq k \leq 0.3$, and in active regions $|B| \sim I$. From these relationships it is inferred that $|B| \sim n_e^2$ in quiet regions and $|B| \sim n_e^1$ in active regions. In addition, the photospheric field beneath a coronal hole is found to be virtually identical to that beneath normal quiet regions. (auth)

30386 DYNAMICAL MODEL FOR THE CHROMOSPHERE–CORONA TRANSITION REGION. Chiuderi, C. (Osservatorio Astrofisico di Arcetri, Florence); Riani, I. Solar Phys.; 34: No. 1, 113-124(Jan 1974).

A dynamical, homogeneous model of the chromosphere–corona transition region and of the lower corona is presented, based on the hydrodynamical equations and on a semi-empirical relation deduced from radio observations. The model is shown to be in agreement with radio and uv observations and with the particle flux given by solar-wind measurements. A comparison with the analogous static model shows that dynamical effects are very small. From the model it is possible to give an estimate of the

energy dissipated at each level by the waves that propagate in the solar atmosphere. It is shown that this energy source cannot be neglected with comparison to the usual conductive, convective, and radiative sources. The importance of the kinetic energy flux connected with the spicules is also discussed. (auth)

30387 FINE STRUCTURE OF THE SUN AT 1.3 CM WAVELENGTH. Kundu, M. R.; Velusamy, T. (Univ. of Maryland, College Park). Solar Phys.; 34: No. 1, 125-131(Jan 1974).

The two-element interferometer at Hat Creek Observatory was used at 1.3 cm wavelength to study the fine structure of the radio emissive regions on the Sun. Observations of the quiet Sun at 1.3 cm show sudden changes in the fringe amplitude and phase, lasting for typically about 5 to 8 min. Assuming that these events are identical in nature, a plot of peak amplitude vs the projected baseline at the time of the event suggests emission from a region of angular size of about 10''. The corresponding brightness temperature is 50,000K. It is possible that these events may be related to the appearance and disappearance of groups of spicules or mottles. (auth)

30388 STATIONARY EQUATIONS OF HYDROGEN EXCITATION AND IONIZATION IN PROMINENCES. Chultem, T.; Yakovkin, N. A. Solar Phys.; 34: No. 1, 133-150(Jan 1974).

The statistical equilibrium equations for the continuum and first 10 levels of a hydrogen atom show that the radiation of a bright prominence (the brightness of the H_α line has attained 56 mÅ of the disc center spectrum) is completely due to scattering of the Sun radiation. The basic unknowns are separated with certainty: electron concentration ($n_e = 3.0 \times 10^{10}$ cm^{-3}), effective thickness ($l = 4.2 \times 10^9$ cm), and electron temperature ($T_e = 5000$ K). Radiation of a very bright prominence ($A_\lambda(H_\alpha) = 213$ mÅ; $T_e = 7300$ K; $n_e = 5.0 \times 10^{11}$ cm^{-3}; $l = 1.3 \times 10^9$ cm) is on account of electron impacts (40%) and the Sun radiation scattering (60%). The parameters are shown to depend greatly on the prominence optical thickness in the lines of the first subordinate series of a hydrogen atom. In the course of determination all the parameters and 100 interconnected integral equations of the radiation diffusion have been thickness-averaged; the population of levels has been calculated by observations using the self-absorption factors. (auth)

30389 FORK-TYPE SOLAR RADIO BURSTS. Zaitsev, V. V.; Zinichev, V. A. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 1, 5-10(1974). (In Russian).

The results of experimental investigation of fork-type solar radio bursts are given. Dynamic spectra of these bursts characterize the appearance or disappearance of a split state and support the Doppler nature of splitting. (auth)

30390 OBSERVATION OF INFRARED SOLAR SPECTRUM. II. Tanaka, W.; Suemoto, Z. (Tokyo Univ.). Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 9: No. 1, 231-243(May 1973). (In Japanese).

Observation of the infrared solar spectrum was performed with a balloon. The apparatus used for the observation consisted of a double axis Sun-follower, a Sun aspectmeter, an infrared scanning monochrometer, and a synchronized amplifer. The whole system was covered with foaming plastic. The Sunfollower was designed to be regulated within ± 0.1°, and used also as a telescope. The aspectmeter consisted of a rotating slit, a Fabry lens, and a phototube. The scanning monochrometer was a Czerny-Turner type. The volume of the balloon was 5000 m^3. Balloon flight was performed at 8:00, September 14, 1970, at the Balloon Laboratory in Haramachi City. Horizontal flight was made at 27 km for about 4 hours. Average observation position was 139.8 East and 37.5° North. The output of the telemeter was recorded with a pen recorder. The number of observed spectrum lines was 1300, and 160 are shown in a table. Most of them were identified by Rowland's Table, a table by Swensson et al. and a table by Mohler. A few lines were not identified. The theoretical resolving power was 0.2 Å. However, various causes make the resolving power worse. Among them, the thermal expansion of the monochrometer largely affected the resolving power. The half-width of the observed spectrum lines was 0.8 Å at 8000 Å, 0.7 Å at 10,000 Å, and 0.6 Å at 12,000 Å for narrow absorption lines. It was concluded that the observed spectrum corresponded to that of the center of the photosphere. (JA)

30391 HYDROMAGNETIC EMISSION OF INTERPLANETARY PLASMA. Gul'el'mi, A. V.; Dobnya, B. V. (Inst. of Earth Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 10, 353-355(20 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 10, 601-604(20 Nov 1973).

Observation of hydromagnetic emission in the 0 to 2 Hz band is reported; a distinguishing feature of this emission is deep carrier modulation. It is suggested that this emission is excited in the interplanetary plasma. (auth)

30392 CORRELATION BETWEEN THE LAMBDA5303 CORONAL INTENSITY AND GEOMAGNETIC ACTIVITY IN THE YEARS 1958-1964. Gulbrandsen, A. (Norges Landbrukshoegskole, Vollebekk). Phys. Norv.; 7: No. 2, 65-88(1973).

The relationship between coronal λ5303 intensity and the geomagnetic ΣKp-indices has been investigated statistically using the method of superposed epochs. The study covers the years 1958-1964. A "negative correlation" between λ5303 intensity and geomagnetism is found, in agreement with earlier findings by Bell & Glazer (1957) and others. The Mustel and Allen–Saemundsson M-region hypotheses are also discussed. The negative correlation fits in well with the Allen–Saemundsson hypothesis, and clearly favours coronal regions of open magnetic field structure and low density as sources of high-speed solar wind. No evidence is found in favour of Mustel's hypothesis, and it is tentatively concluded that this hypothesis is based on a misinterpretation. A coronal L-zone as described by Gulbrandsen (1973b) is found to be located about 2 days east of a solar magnetic sector boundary. It is suggested that the most typical λ5303 intensity pattern in years of declining solar activity consists of 2 L-zones and 2 high intensity zones per solar rotation. This in turn implies the existence of only 2 magnetic sectors per solar rotation at this phase of the solar cycle. It is further suggested that interplanetary magnetic sector boundaries may originate from coronal field line structures associated with both old and young solar centers of activity. (auth)

30393 QUASILINEAR SPECTRUM OF LONGITUDINAL PROTON CYCLOTRON WAVES DRIVEN BY THERMAL GRADIENT EFFECTS IN THE SOLAR WIND. Harvey, R. W. San Diego, CA; Univ. of California (1973). 164p. University Microfilms Order No. 74-2379.

Thesis (Ph. D.).

Longitudinal proton cyclotron waves are studied as a possible explanation for solar wind observations of an enhancement of the power spectrum of electron density irregularities at spatial scales the order of several ion gyroradii. These waves may be excited by the effective electron current associated with thermal conduction effects in the interplanetary plasma. Using quasilinear theory and including Coulomb collision effects, a quasistationary spectrum of these waves is found for two cases: 1) quasilinear relaxation of the electrons but a bi-Maxwellian distribution for the protons, and 2) quasilinear relaxation of both the electron and proton distributions. (WDM)

30394 ASTROPHYSICAL QUANTITIES. Allen, C. W. London; Athlone Press (1973). 320p.

The introduction explains the general plan of the book, the symbols, headings and notation used: the subject is then dealt with in chapters, entitled: general constants and units; atoms; spectra; radiation; Earth; planets and satellites; interplanetary matter; Sun; normal stars; stars with special characteristics; star populations and the solar neighbourhood; nebulae, sources and interstellar space; clusters and galaxies; incidental tables. (UK)

30395 EFFECT OF THE SOLAR WIND ON GEOMAGNETIC ACTIVITY. Chirenti, A.; Pizella, G. (Lecce Univ., Italy). Riv. Ital. Geofis.; 22: 71-73(1973). (In Italian).

A study is presented of the correlation between the parameters of the solar wind and the Kp and Dst geomagnetic indices during a period of high solar activity. The analysis is based on solar-wind data obtained from measurements performed on the European satellite HEOS-1 during the period from Dec. 5, 1968, to Mar. 1, 1970. In studying the correlation between the two geomagnetic indices and the solar-wind density, bulk velocity, and temperature, it is found that the best correlation is between the bulk velocity and Kp. In addition, Kp varies about one to two hours before the bulk velocity varies. It is suggested that the variation of the Kp index is due to the compression of the geomagnetic field lines which occurs before the solar-wind particles reach the magnetosphere. (IAA)

30396 CORONAL AUREOLA IN THE TIME OF TOTAL SOLAR ECLIPSE. Koutchmy, O. (Univ., Paris); Koutchmy, S. Astron. Astrophys., Suppl. Ser.; 13: No. 3, 295-303(Mar 1974).

A computational method allowing one to obtain the intensity of the coronal aureola from the measures of the solar aureola is proposed. The method is applied to 2 very different observations performed at the solar eclipses at Sept. 22, 1968 and March 7, 1970. In addition, a scattering function is given for some typical cases observed (clear sky) showing a large variety in values. Use of this type of function is suggested in order to describe the scattered light superimposed on the lunar earthshine and the sky background. For good observing conditions, it is shown that the coronal aureola is everywhere one order of magnitude less than the F-corona but becomes higher than the minimum electronic corona, for $r > 2.5$. When the sky background is important,

especially because of the low value of the eclipse magnitude, the intensity of coronal aureola may be compared to the F-corona intensity. (auth)

30397 NEW LABORATORY MEASUREMENTS OF THE $A^2\Pi - X^2\Sigma$ AND $B^2\Sigma - X^2\Sigma$ TRANSITIONS OF CaH. Berg, L. E.; Klynning, L. (Univ. of Stockholm). Astron. Astrophys., Suppl. Ser.; 13: No. 3, 325-344(Mar 1974).

The absorption spectrum of calcium hydride in the region 6130 to 7125 Å was photographed using a 10.685 m concave grating spectrograph. Wavelengths, vacuum wave numbers, and identifications of 1425 lines from 10 bands belonging to the $A^2\Pi - X^2\Sigma$ and $B^2\Sigma - X^2\Sigma$ transitions are listed. (auth)

30398 REMARKS CONCERNING THE SOLAR RADIO EMISSION IN THE DECIMETRIC BAND. Zieba, S. (Jagellonian Univ., Krakow). Postepy Astron.; 21: No. 4, 305-311(1973). (In Polish).

It is suggested, based on solar radio observations from the period 1957–1967, that the basic component and the slowly varying component of the solar emission on various wavelengths may behave differently in different phases of the solar activity cycle. This different behavior may explain the observed changes in the ratios of the monthly means of flux densities calculated for various frequencies in the decimetric wavelength range. (auth)

30399 INVESTIGATION OF THE COMPOSITION OF GASES FROM INCLUSIONS IN TECTITES AND COSMIC DUST. Dolgov, Yu. A. (Inst. of Geology and Geophysics, Moscow). Meteoritika; No. 33, 122-129(1974). (In Russian).

The results of the volumetric microanalysis of gases from inclusions in tektites and silicate microspherules from the region of the impact of the Tungusk meteorite are reported. From the chemical composition, the tectites and the Tungusk microspherules are similar but differ somewhat in the alkalis and alumina. They have analogs neither with the composition of terrestrial rocks nor meteorites. Similar glasses were found on the Moon. (tr-auth)

30400 NUCLEAR REACTIONS IN MATTER OF THE SOLAR SYSTEM. Lavrukhina, A. K.; Kuznetsova, R. I.; Rupp, E. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Meteoritika; No. 33, 14-22(1974). (In Russian).

The most precise quantitative evaluation was made of the effects of nuclear reactions with fast protons in all stages of evolution of matter of the solar system. It was shown that nuclear reactions in stone meteorites, caused by galactic cosmic radiation, can not lead to a change of the primary isotopic composition of the nonvolatile elements. Nuclear reactions with fast protons do not play a role in the formation of nuclides of the matter of the solar system either in stages of irradiation of the protosolar nebula with galactic cosmic radiation or in stages of irradiation with solar proton of the protoplanetary cloud in the period of the differentiation of its chemical composition. For the first time the observed abundances of the light elements and the nuclides with $A < 180$ were coordinated in the framework of the model of proton irradiation in the hydrogen-rich matter of the shell of a supernova. The integral proton flux was I_p ($E_p > 25$ MeV) = 5×10^{21} protons/cm^2. The duration of the irradiation is ≥10 days. The basic synthesis of the heavy nuclei occurred 10.6 million years ago. The most probable source of ^{26}Al in the matter of the solar system is its formation in reactions with fast protons in the shell of a supernova. The quantity at the end of the process is 10 atoms/10^6 atoms of Si. One of its roles as a source of heating of large bodies is limited by its lifetime. It was determined that even 4.5×10^6 years after the flare its quantity is insufficient for heating up large bodies. (tr-auth)

30401 ORIGIN OF ISOTOPES OF RARE GASES. Levskii, L. K. (All-Union Scientific-Research Inst. of Geology, Leningrad). Meteoritika; No. 33, 23-29(1974). (In Russian).

The previously established two-component atomic structure of rare gases was confirmed by study of the isotopic composition of He, Ne, Ar, Kr, and Xe in meteorites. The different relative abundance of type A and B rare gases in meteorite material and the different genesis of these gases are discussed. (tr-auth)

30402 CONCENTRATION OF RARE EARTH ELEMENTS IN FIVE ORDINARY CHONDRITES. Kolesov, G. M. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Meteoritika; No. 33, 42-46(1974). (In Russian).

The concentration of rare-earth elements in the chondrites Saratov, Elenovka, Pervomaiskii Poselok (L group), Zaisan, and Zhovtnevyi Khutor (H group) was determined by neutron activation. It was established that (1) in meteorites of the L group in comparison with the chondrites of the H group the light rare-earth elements (from La to Eu) slightly predominate; (2) the concentration of the light rare-earth elements increases in the series L3-4–L6 and H4-5–H6; (3) the atomic abundances of the light rare-earth elements in the chondrites of the L group are somewhat higher than in the chondrites of the H group and lower than the average atomic abundances of the rare-earth elements in chondrites of all types. The abundances of the heavy rare-earth elements (from Gd to Lu) in chondrites of the H group are higher than the abundances of the rare-earth elements in chondrites of the L group and coincide with the average atomic abundances of the rare-earth elements in chondrites. (tr-auth)

30403 ^{14}C IN IRON METEORITES AND DETERMINATION OF THE TERRESTRIAL AGE OF THE FIND. Alekseev, V. A.; Ivliev, A. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Meteoritika; No. 33, 47-48(1974). (In Russian).

A method for the separation of C from iron meteorites is briefly described. Data are given on the separation of C and the measurement of the ^{14}C activity in the iron meteorites Yardymlinskii and Burgavli. The time of the impact of Burgavli meteorite on the Earth was about 4100 years ago. (tr-auth)

30404 DEVELOPMENT AND SPATIAL STRUCTURE OF THE PROTON FLARES NEAR THE LIMB, AND CORONAL PHENOMENA VI-HEIGHTS OF IMPULSIVE RADIO AND X-RAY EMISSION SOURCES FOR EVENTS FROM NOVEMBER 2, 1969 AND SEPTEMBER 1, 1971. Krivsky, L. (Astronomical Inst., Ondrejov, Czech.); Krueger, A. Bull. Astron. Inst. Czech.; 24: No. 5, 291-295(1973).

30405 DIATOMIC MOLECULES IN FACULA MODELS. Tripathi, B. M.; Pande, M. C. (Uttar Pradesh State Observatory, Naini Tal, India). Bull. Astron. Inst. Czech.; 24: No. 5, 296-298 (1973).

Molecular abundances predicted by several solar facula models are compared, and the possible presence (or absence) of molecular lines belonging to CO(+) and MgH molecules in the facular spectrum is theoretically evaluated. Results of dissociation equilibrium calculations in three facula models indicate that more molecules form in the 7B2J model proposed by Chapman (1970). Equivalent width calculations for the Chapman model show that the MgH 5165.958-A and the CO(+) 7349.272-A lines should not be detectable in the facular spectrum. (IAA)

Galaxies

30406 DIGITAL ANALYSIS OF THE COLOR STRUCTURE WITHIN MESSIER 51. Worden, S. P. (Univ. of Arizona, Tucson). Publ. Astron. Soc. Pac.; 86: No. 509, 92-98(Feb 1974).

Blue and visual photographic plates of Messier 51 were digitally analyzed to give computer produced (B–V) maps of M51. The technique used to accomplish this is described and this material is compared with the preliminary Westerbork 21-cm neutral hydrogen data. The indication of a ring of blue stars in the nucleus of M51 is reported. (auth)

30407 SPIRAL AND IRREGULAR GALAXIES ASSOCIATED WITH RICH REGULAR CLUSTERS. Rood, H. J. (Inst. for Advanced Study, Princeton, NJ). Publ. Astron. Soc. Pac.; 86: No. 509, 99-103(Feb 1974).

Thirty galaxies brighter than $m_p = 15.7^m$ in a 23 square-degree region centered on the Coma cluster are classified as spirals and irregulars on 48-inch Schmidt plates. The radial surface density distribution of these galaxies, corrected for contamination by field galaxies, indicates that about 15% of the galaxies associated with the cluster in the brightest 2.7-magnitude interval are spirals and irregulars. The homogeneous radial distribution of spirals and irregulars in a 2-square-degree region centered on Abell 2199 suggests that all or nearly all of these galaxies are members of the field. The above conclusions are provisional because (1) they are derived from relatively small samples of galaxies and (2) galaxy classifications from 48-inch Schmidt plates could contain significant uncertainties. (auth)

30408 DENSITY WAVES IN SPIRAL GALAXIES HYDRODYNAMIC STUDY. Van Humbeeck, E. (Univ., Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 59: No. 7, 611-630(1973). (In French).

A hydrodynamic method, including moments to second order, is applied to the study of the spiral structure of the Galaxy. An exchange relation relating moments of order 3 to moments of order 2 allows the realization of closure of the system of equations for the moments of the indicated order. A system of 6 equations for the partial derivatives of first order, with 6 unknowns, is obtained in the case of a galactic disk of infinitesimal thickness and average velocities, the last 3 unknowns are related to the velocity dispersions (by this is understood the velocity deviation). The normal oscillation modes of a low level (Schmidt model) are considered in a linear and asymptotic theory with respect to the resolution of the Poisson equation.

The dispersion relation relative to the spiral modes is studied in the case of neutral oscillations. A criterion of optimality is extended to the spiral arms of the galactic disk leading to a value of the angular rotational velocity (Ωp) equal to 22.2 km/sec Kpc. The corresponding values for the separation of the arms, deduced from dispersion relations, are in good agreement with observation (~3.3 Kpc in the neighborhood of the Sun). The fluctuations of the results are studied as a function of the exchange coefficient. A possible value for this coefficient can be deduced for the Galaxy. (tr-auth)

30409 MOLECULES IN SPACE: THEIR DISCOVERY AND IMPORTANCE. Pecker, J. C. Compt. Rend., Ser. C; 277: No. 24, 149-155(17 Dec 1973). (In French).

Historical aspects of the discovery of molecules in space are presented. The coexistence of molecules, atoms, photons, and interstellar and circumstellar dusts in the Galaxy is discussed. The discovery in the last five years of a large number of interstellar molecular bodies has greatly changed the conception of the near galactic Universe and tends to associate phenomena connected with the appearance of life with the evolution of the Universe. (FR)

30410 UBV PHOTOMETRY ON THIRTY-EIGHT SOUTHERN GALAXIES. Alcaino, G. (Universidad Catolica de Chile, Santiago). Astron. Astrophys., Suppl. Ser.; 13: No. 3, 305-313(Mar 1974).

The integrated magnitudes and colors of thirty-eight southern galaxies brighter than V ≈ 14 were observed in the UBV system with the 1 m photometric telescope of the European Southern Observatory. All observations were done through a 21 second of arc diaphragm. The galaxies were selected from Sersic's "Atlas" (1968). They range in all types as follows; three ellipticals, six SO, three Sa, Six Sb, ten Sc, four SB, six peculiar. Plots of the uncorrected U−B vs B−V colors for all galaxy types define a mean galaxy sequence in agreement with earlier data. (auth)

30411 RADIO OBSERVATIONS OF ABELL 1314. Webber, J. C. (Univ. of Illinois, Urbana). Publ. Astron. Soc. Pac.; 86: No. 510, 223-224(Apr 1974).

The cluster of galaxies Abell 1314 has been observed at three radio frequencies. Tentative optical identifications for the two radio sources detected are made. (auth)

30412 EVOLUTION OF GALAXIES. Kuroczkin, D. (Astronomical Inst., Torun, Poland). Postepy Astron.; 21: No. 4, 283-291(1973). (In Polish).

The theory of Truran and Cameron concerning the chemical evolution of the Galaxy is described, as well as the photometric properties obtained from the galactic model calculations. Also a few observational facts are given. (auth)

Cosmology

Refer also to abstract 31132.

30413 (LBL-2258) FAR INFRARED SPECTROMETRY OF THE COSMIC BACKGROUND RADIATION. Mather, J. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1974. Contract W-7405-eng-48. 211p. Dep. NTIS $13.75.

Thesis.

Two experiments to measure the cosmic background radiation near 1 mm wavelength are described. The first was a ground-based search for spectral lines, made with a Fabry−Perot interferometer and an InSb detector. The second is a measurement of the spectrum from 3 to 18 cm^{-1}, made with a balloon-borne Fourier transform spectrometer. It is a polarizing Michelson interferometer, cooled in liquid helium, and operated with a germanium bolometer. The theory of operation, construction details, and experimental results are given. The first experiment was successfully completed but the second suffered equipment malfunction on its first flight. The theory of Fourier transformations is described and a new understanding of convolutional phase correction computations is given. Far infrared bolometer calibration procedures are discussed and test results on nine detectors are tabulated. Methods of improving bolometer sensitivity with immersion optics and with conductive film blackening are described. (auth)

30414 COSMOLOGICAL MODELS WITH THE COSMICAL CONSTANT CONTAINING MATTER AND RADIATION. Fukui, T. (Dokkyo Univ., Japan). Sci. Rep. Tohoku Univ., First Ser.; 56: No. 1, 1-13(Jul 1973).

This paper deals with the cosmological models with the cosmical constant on the assumption of functional forms of the rate of energy transfer between matter and radiation in order to see the effect of an interacting matter and radiation on the cosmological quantities. Also discussed is the transfer of energy between matter and radiation by considering matter pressure as well. (auth)

30415 ELEMENT FORMATION IN A CHAOTIC EARLY UNIVERSE. Tomita, K. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 4, 1285-1301(Oct 1973).

Element formation in primordial irregularities in a chaotic early Universe is investigated. In order to analyze how nuclear reactions proceed, the velocity field, the radiation temperature, and the matter density in the irregularities are derived, and the reaction rates are compared with the expansion rate. It is concluded as a result that the irregularities are classified into three types: I) The irregularities of small size or low velocity; the elements are formed as in Friedman's model Universe, II) the irregularities of intermediate size and velocity; the formed elements depend on the primordial composition of elementary particles, and III) the irregularities of large size and high velocity; no element can be formed, except for hydrogen. Moreover, two routes of element formation in the Universe are discussed in connection with the observed abundance of elements. It is also indicated that neutrino viscosity is ineffective for the irregularities of types II and III. (auth)

30416 SUPER HEAVY ELEMENTS IN COSMOCHEMISTRY. Ohnishi, T. (Kyoto Univ. Uji, Japan). Kagaku No Ryoiki; 27: No. 7, 577-584(Jul 1973). (In Japanese).

Possibility of the synthesis or existence of the super-heavy element of atomic number around 114 is discussed. Nilsson et al. calculated the stability of the super-heavy element by using harmonic oscillator potential and by considering quadrupole and octopole deformation. Large energy gaps were shown at atomic numbers of 50, 82, 114, 124, and 164 and at neutron numbers of 82, 126, 170, 184, 196, and 236. The calculation by Chepurnov by using Wood−Saxon potential showed the same result, and Friedman also found stable islands at Z = 114 and N = 164. Nilsson et al. estimated that the most stable nucleus is $^{294}110$ with the half-life of 10^9 years. It is expected that the super-heavy element around Z = 110 is formed in the cosmos. Three processes of formation are considered. One is the process of slow capture of neutrons (s process), the second is the process of fast capture (r process), and the third process is due to the formation of nuclei with excess protons (p process). The super-heavy element may be formed by the r process. Other processes such as $p + e^- \rightarrow n + \nu$ and $^{208}Pb + {}^{78}Ni$ are discussed. The possibility of existence of super-heavy elements in the cosmos is suggested from the following facts. One is the abnormality of abundance of rare gases in meteorites, and the other is the existence of elements of large atomic number, such as Z = 92, in primary cosmic rays. The space where the super-heavy elements may be synthesized is discussed. (JA)

30417 RELATION BETWEEN THE SCHWARZSCHILD AND TOLMAN METRICS. Stanyukovich, K. P.; Sharshekeev, O. Sh. Porosh. Met., Akad. Nauk Ukr. SSR; 37: 739-745(1973). (In Russian).

A method of solution is described which satisfies the correspondence principle when passing from the Schwarzschild to the Tolman reference frames or vice versa. A procedure is outlined for solving the Schwarzschild problem in the Tolman metric, stressing the importance of determining a Jacobian which satisfies certain formulated requirements so as to ensure that the solution is entirely correct. The proposed procedure is applied to an analysis of three different regimes of motion. (IAA)

30418 COSMOLOGY. Zeldovich, Ya. B. pp 729-735 of Reports on Astronomy. Dordrecht, Netherlands; D. Reidel Publishing Company (1973).

A review of a number of unsolved problems in cosmology is presented. Arguments for and against the big-bang theory are presented, particularly arguments concerning the redshift and the origin of the radio background radiation. The question of matter−antimatter symmetry in the Universe is discussed, as well as the problem of nucleogenesis. Measurements of the radio background, the Hubble constant, and the matter density in galaxies are discussed, physical processes near the cosmological singularity are considered, and theories of formation of galaxies are described. In particular, the vortex theory of galaxy formation is evaluated. (IAA)

30419 HOMOGENEOUS COSMOLOGICAL MODEL FILLED WITH DISORDERED RADIATION. Waghmare, B. B. (Shivaji Univ., Kolhapur, India). J. Shivaji Univ.; 5: No. 10, 109-114 (1972).

Under the assumptions that the flow is shear-free and geodesic and that the spherically symmetric space−time conformally flat, it is established that a relativistic thermodynamical perfect

fluid distribution in a comoving co-ordinate system degenerates into disordered radiation field in an inertial reference frame (in the sense of Audretsch). Besides, an exact class one conformally flat static solution of the field equations is obtained which reduces to the Minkowskian metric near the origin. The model corresponds to a homogeneous universe filled with disordered radiation. In the absence of pressure, the model reduces to flat space–time. It is found that only one independent component of each of the following tensors exists: i) the super-energy tensor of Bel ii), the projective curvature tensor of Weyl, and iii) the substance tensor of Gliner. It is observed that the Gliner tensor is proportional to the second dual of Riemann–Christoffel curvature tensor. (auth)

30420 NEUTRINO FIELD IN COSMIC SPACE. Kuchowicz, B. (Univ. of Warsaw). Postepy Astron.; 21: No. 4, 331-334 (1973). (In Polish).

The very weak neutrino–matter interaction points to the fact that a relatively large contribution of the neutrino density to the overall density of matter cannot be excluded. The neutrino problem in the Universe was usually related to a transition from open to closed Friedmann models, and to a possible laboratory testing of the degenerate neutrino background. Now, the effect of the neutrino upon cosmology can be much deeper. Not only in the initial evolution stage of the Universe but even at the present epoch the neutrino background can decisively influence the structure of the space-time, in such questions as the possibility of a spherical symmetry, and in the transition from Riemann manifolds to more general ones (e.g., those with an inherent torsion). (auth)

Planetary Phenomena

30421 SEARCH BY MARINER 10 FOR ELECTRONS AND PROTONS ACCELERATED IN ASSOCIATION WITH VENUS. Simpson, J. A.; Eraker, J. H.; Lamport, J. E.; Walpole, P. H. (Univ. of Chicago). Science; 183: No. 4131, 1318-1321(29 Mar 1974).

The University of Chicago instruments on board the Mariner 10 spacecraft bound for Mercury have measured energy spectra and fluxes of electrons from 0.18 to 30 MeV and protons from 0.5 to 68 MeV along the plasma wake and in the bow-shock regions associated with Venus. Unusually quiet solar conditions and improved instrumentation made it possible to search for much lower fluxes of protons and electrons in similar energy regions as compared to earlier Mariner missions to Venus—that is, lower by a factor of 10^3 for protons and 10^3 for electrons. No evidence was found for electrons or protons either in the form of increases of intensity or energy spectral changes in the vicinity of the planet, nor any evidence of bursts of radiation in or near the observed bow shock where bursts of electrons might have been expected in analogy with the bow shock at the Earth. The importance of these null results for determining the necessary and sufficient conditions for particle acceleration is discussed with respect to magnetometer evidence that Venus does not have a magnetosphere. (auth)

30422 MAGNETIC FIELD OBSERVATIONS NEAR VENUS: PRELIMINARY RESULTS FROM MARINER 10. Ness, N. F. (Goddard Space Flight Center, Greenbelt, MD); Behannon, K. W.; Lepping, R. P.; Whang, Y. C.; Schatten, K. H. Science; 183: No. 4131, 1301-1306(29 Mar 1974).

The NASA-GSFC magnetic field experiment on Mariner 10 is the first flight of a dual magnetometer system conceived to permit accurate measurements of weak magnetic fields in space in the presence of a significant and variable spacecraft magnetic field. Results from a preliminary analysis of a limited data set are summarized in this report, which is restricted primarily to Venus encounter. A detached bow shock wave that develops as the super Alfvénic solar wind interacts with the Venusian atmosphere has been observed. However, the unique coincidence of trajectory position and interplanetary field orientation at the time of bow shock crossing led to a very disturbed shock profile with considerably enhanced upstream magnetic fluctuations. At present it is not possible to ascertain the nature and characteristics of the obstacle responsible for deflecting the solar-wind flow. Far downstream disturbances associated with the solar-wind wake have been observed. (auth)

30423 OBSERVATIONS AT VENUS ENCOUNTER BY THE PLASMA SCIENCE EXPERIMENT ON MARINER 10. Bridge, H. S. (Massachusetts Inst. of Tech., Cambridge); Lazarus, A. J.; Scudder, J. D.; Ogilvie, K. W.; Hartle, R. E.; Asbridge, J. R.; Bame, S. J.; Feldman, W. C.; Siscoe, G. L. Science; 183: No. 4131, 1293-1296(29 Mar 1974).

Preliminary results from the rearward-looking electrostatic analyzer of the plasma science experiment during the Mariner 10 encounter with Venus are described. They show that the solar-wind interaction with the planet probably involves a bow shock rather than an extended exosphere, but that this is not a thin boundary at the point where it was crossed by Mariner 10. An observed reduction in the flux of electrons with energies greater than 100 electron volts is interpreted as evidence for some direct interaction with the exosphere. Unusual intermittent features observed downstream of the planet indicate the presence of a comet-like tail hundreds of scale lengths in length. (auth)

30424 ANALYTICAL METHODS DEVELOPED FOR APPLICATION TO LUNAR SAMPLES ANALYSES. Proceedings of the Symposium, Los Angeles, California, June 26–30, 1972. ASTM Special Technical Publication, No. 539. Philadelphia; American Society for Testing and Materials (1973). 156p. $15.00.

Aspects of the environmental control of lunar samples in the lunar receiving laboratory are considered together with questions of organic contamination monitoring and control, monitoring systems for the evaluation of terrestrial contamination in a lunar sample transfer facility, and mass spectrometric analysis of the volatiles released by heating or crushing rocks. Other topics discussed include a method for ultraaccurate oxygen determination for rare reference samples, techniques for the analysis of gases sequentially released from lunar samples, microsampling techniques for the ir spectroscopic analysis of lunar and terrestrial minerals, and polarized crystal-field spectra of microparticles of the Moon. Questions of isotopic abundance determinations of submicroamounts of rhenium by neutron activation are also explored. (IAA)

30425 ISOTOPIC ABUNDANCES DETERMINATION OF SUBMICRO AMOUNTS OF RHENIUM BY NEUTRON ACTIVATION. Michel, R.; Herpers, U.; Kulus, H.; Herr, W. (Univ., Cologne). pp 140-150 of Analytical Methods Developed for Application to Lunar Samples Analyses. Philadelphia; American Society for Testing and Materials (1973).

From conference on analytical methods developed for application to lunar samples analyses; Los Angeles, CA (25 Jun 1972).

30426 APPLICATION OF 14 MeV AND ^{252}Cf NEUTRON SOURCES TO INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF LUNAR SAMPLES. Janghorbani, D. E. (Ashland Community Coll., KY); Gilium, D. E.; Ehmann, W. D. pp 128-139 of Analytical Methods Developed for Application to Lunar Samples Analyses. Philadelphia; American Society for Testing and Materials (1973).

From conference on analytical methods developed for application to lunar samples analyses; Los Angeles, CA (25 Jun 1972).

30427 DISTRIBUTION OF ATOMIC HYDROGEN IN THE THERMOSPHERE AND EXOSPHERE OF MARS AS DETERMINED FROM MARINER 6, 7, AND 9 ULTRAVIOLET MEASUREMENTS. Anderson, D. E. Jr. Boulder, CO; Univ. of Colorado (1973). 123p. University Microfilms Order 73-32,504.

Thesis (Ph. D.).

Four Lyman-α airglow measurements of the limb and disc of Mars, made by ultraviolet spectrometers on Mariner 6 and 7 in 1969 and Mariner 9 in 1971, are analyzed to determine the amount and distribution of atomic hydrogen above 80 km. The variation of atomic hydrogen with altitude is calculated using time-independent, chemical-diffusion models from 80 km to 250 km, and an exospheric model is used above 250 km. Employing radiative transfer theory that includes effects of pure absorption and accounts for temperature variations in the atmosphere, a spherical model of the airglow Lyman-α emission is used to produce theoretical intensities for comparison with the data. It is found that: (1) the exospheric temperature and distribution in 1971 is consistent with that determined in 1969; (2) the vertical optical depth above 80 km is 2.2 in 1969 and 5 in 1971; and (3) the derived atomic hydrogen distribution from 80 km to 250 km requires a source of atomic hydrogen above 80 km. Comparison of observed atomic hydrogen profiles with chemical-diffusion models implies a large downward flow of atomic hydrogen at 80 km coupled with a large upward flow of molecular hydrogen. (Diss. Abstr. Int., B)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

30428 (AD-762481) TOTAL ELECTRON CONTENT STUDIES OF THE IONOSPHERE. Air Force Survey in Geophysics. Klobuchar, J. A.; Mendillo, M.; Basu, S.; Seeman, D. R.; Aarons, J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 1 Feb 1973. 69p. (AFCRL-TR-73-98; AFCRL-AFSIG-257). NTIS $5.50.

Radio waves that pass through the ionosphere travel more slowly than their free space velocity due to the group path delay of the ionosphere. This group path delay, directly proportional to the total electron content of the ionosphere, can be an important source of error to vhf, uhf, and L-band satellite detection radars and satellite navigation systems. In this report, the current state of knowledge of ionospheric total electron content is outlined, with special emphasis placed on the North Atlantic region of the world due to NATO special requirements of this region. A numerical model of total electron content, valid over the European continent under certain conditions, is presented for systems engineering use for an average background total electron content correction. Typical values of total electron content are also given at various locations in the high, middle, and equatorial latitudes. If the results presented seem incomplete, it is only because the state of knowledge of the total electron content parameter is still incomplete. With more observational data being taken at many locations, an overall satisfactory picture of the world-wide behavior of this important parameter is beginning to emerge. (auth)

30429 (AD-769279) NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) PROGRAMS RELATED TO HIGH-ALTITUDE EFFECTS SIMULATION. Hinrichs, C. K. (Stanford Research Inst., Menlo Park, Calif. (USA)). Jun 1973. Contract DNA001-72-C-0143. 21p. (DNA-3194-T). NTIS $2.75.

The high-altitude effects simulation (HAES) program is a DNA effort to obtain indirectly information on the reaction of the upper atmosphere to nuclear explosions. In the absence of actual nuclear testing in the atmosphere, a number of experiments are being carried out in both the laboratory and the field to determine a sufficient number of parameters to characterize the environment and its reactions in the suitable model. Where disturbance levels in the simulations fall short of those induced by a weapon burst, particular attention is given to understanding the associated phenomena and reliability of extrapolation to weapon levels. The report discusses work done at the Space Environment Laboratory and the Aeronomy Laboratory which is of interest to the HAES program. (GRA)

30430 (AD-769668) SOLAR IONIZATION RATES FOR THE IONOSPHERIC E, F, AND D REGIONS. Ali, A. W.; Kepple, P. C. (Naval Research Lab., Washington, D. C. (USA)). 25 Oct 1973. 35p. NTIS $3.00.

Two approaches were taken to calculate the photoionization rates for the ionosphere. First, a detailed line-by-line deposition for the range 1 to 1215A was carried out by using experimental or theoretical absorption and ionization cross sections for the atmospheric species. The second approach was to contract these lines into bands having approximately 11 bands for each region, and to calculate the photoionization rate for these new bands. The total photoionization rates for the two methods agree very well. (auth) (GRA)

30431 RADIO WAVE PROPAGATION AND THE IONOSPHERE. Volume 1. The Ionosphere. Al'pert, Y. L. New York; Plenum Publishing Corporation (1973). 440p. $32.50.

Translated from the Russian by Richard B. Rodman.

New methods recently introduced into experimental research have resulted in significant advances in the field of radio wave propagation. This volume deals with the nature and definition of the ionosphere and considers such important topics as: the concept of the outer ionosphere; the structure, composition, and properties of the lower ionosphere; and the region at levels from 50-60 km to 80-90 km. (WDM)

30432 POLYARNYE SIYANIYA I SVECHENIE NOCHNOGO NEBA. (Aurorae and Airglow). Krasovskii, V. I. (ed.). Rezul'taty Issledovanii po Mekhdunarodnym Geofizicheskii Proektam. Sbornik Statei, No. 20. Moscow; Izdatel'stvo Nauka (1972). 116p.

Separate abstracts were prepared for the seven articles contained. (WDM)

For abstracts of individual papers see: 30433–30435, and 30446–30449.

30433 BEHAVIOR OF THE HYDROXYL EMISSION DURING SOLAR CYCLE, SEASONS, AND GEOMAGNETIC DISTURBANCES. Shefov, N. N. pp 23-29 of Polyarnye Siyaniya i Svechenie Nochnogo Neba. Krasovskii, V. I. (ed.). Moscow; Izdatel'stovo Nauka (1973).

According to long-term observations at Zvenigorod and other stations, the average seasonal variations of intensity and rotation temperature of hydroxyl emissions at different latitudes were obtained. OH variations for the whole solar cycle are presented. The OH intensity and rotation temperature are found to depend on geomagnetic disturbances of different intensities. Regular variations of intensity and rotation temperature caused by geomagnetic storms occur several days after the storm and last up to 30 days. The time lag depends on the latitude and, near the equator, constitutes about 10 days. This dependence shows that the disturbances are likely to propagate from the region of the aurora with a meridional speed component of 5 to 10 m/sec. The additional energy of the hydroxyl emission resulting from geomagnetic storms is primarily released at latitudes of over 30°. The total planetary energy per geomagnetic storm is the maximum for disturbances with $a_p \sim 140$ and, in this case, it is of the order of 4×10^{23} ergs. (auth)

30434 HYDROGEN AND HELIUM EMISSIONS AND CONCENTRATIONS IN THE UPPER ATMOSPHERE. Shefov, N. N. pp 40-56 of Polyarnye Siyaniya i Svechenie Nochnogo Neba. Krasovskii, V. I. (ed.). Moscow; Izdatel'stvo Nauka (1973).

The major part of present-day information about high-altitude distribution of neutral hydrogen and helium atoms in the upper atmosphere is based on theoretical models constructed with data on atmospheric density obtained by satellite retardation. However, according to some measurements, even the standard CIRA 1965 models can show deviations up to 2 to 3 times for the light components above 600 to 700 km. Optical observations of L_α and H_α hydrogen emissions reveal the spatial distribution of hydrogen and its content in the column. Nevertheless, the behavior of emission H_α requires further study of its variations. Systematic observations of helium emission, whose high-altitude distribution intensity strongly depends upon the temperature, allow to determine the atmospheric structure. An excessive amount of helium is present in the winter hemisphere. However, correct account must be taken of all the excitation and deactivation processes. Direct measurements of light component concentrations are scarce, incidental, inaccurate, and limited to about 700 km. Hence, hydrogen and helium content at high altitudes is known approximately and systematic direct measurements are needed. (auth)

30435 RESULTS OF THE VISUAL OBSERVATIONS OF AURORAS IN 1964–1965 AND DURING CYCLE OF SOLAR ACTIVITY. Lebedeva, Yu. A.; Shevnina, N. F.; Fel'dshtein, Ya. I. pp 77-95 of Polyarnye Siyaniya i Svechenie Nochnogo Neba. Krasovskii, V. I. (ed.). Moscow; Izdatel'stvo Nauka (1973).

During the years of maximum solar activity with the same values of K_p the equatorial border of the aurora in the zenith runs in more southern latitudes than during the years of minimum solar activity. This difference steadily increases as the K_p grows from 0° at $K_p \sim 1$ to 4° at $K_p = 7$. (WDM)

30436 HEIGHT AND DIMENSIONS OF SMALL-SCALE IONOSPHERIC IRREGULARITIES ABOVE ASHKHABAD. Erukhimov, L. M.; Maksimenko, O. I. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 1, 38-42(1974). (In Russian).

The results of measurements of the heights of small-scale ($l \lesssim$ 1 to 3 km) ionospheric irregularities using spatially-spaced reception of Explorer-22 signals in 1967–1968 are presented. It is shown that at the Ashkhabad latitude the relative electron density fluctuations δN for these scales has a complicated height dependence decreasing with the height in the lower F2 layer and increasing on the average with the growth of the height outside the layer. (auth)

30437 ENERGY EQUIVALENCE OF APPLICATION OF DYSON AND BETHE–SALPETER EQUATIONS IN THE THEORY OF MULTIPLE SCATTERING OF WAVES. Barabenenkov, Yu. N. (All-Union Scientific-Research Inst. of Physical-Technical and Radiotechnical Measurement, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 1, 113-120(1974). (In Russian).

Transformed series of the perturbation theory are constructed for the section of coherent radiation absorption and for the full section of incoherent scattering the main terms of which are calculated by solving the Dyson equation in Kraichnan approximation

and Bethe–Salpeter equations in a ladder approximation. Using the optical theorem it is shown that the constructed transformed series are asymptotic under equal conditions. (auth)

30438 THEORETICAL ESTIMATE OF THE EFFECTIVE RECOMBINATION COEFFICIENT IN THE D REGION. Kamiyama, H. (Tohoku Univ., Sendai). J. Geomagnet. Geoelec.; 24: No. 1, 1-17(1972).

In the presence of a large number of positive and negative ionic species, an analytical expression for the effective recombination coefficient of electrons in the D region is derived in the same from, $\alpha' = \langle\alpha_e\rangle + \lambda\langle\alpha_{ion}\rangle$, as is customarily used in the upper regions. Here, $\langle\alpha_e\rangle$ is the electronic recombination coefficient averaged with weights proportional to the abundance of various kinds of positive ions, and $\langle\alpha_{ion}\rangle$ is the weighted mean of the various ionic recombination coefficients according to the composition of positive and negative ions. The effective loss rate of electrons is given as $(1+\lambda)\alpha'$ in which the negative ion–electron ratio, λ, changes in a wide range as a function of altitude. Under the assumption of a model atmosphere containing eight minor constituents, the density distributions of thirteen species of positive ions and seven species of negative ions as well as of electrons are calculated. Based on the result, the effective recombination coefficient is estimated to be 4.2×10^{-7} cm^3 sec^{-1} at the 80 km-level, 1.5×10^{-6} cm^3 sec^{-1} at 70 km, and 1.9×10^{-5} cm^3 sec^{-1} at 60 km, while λ increases rapidly with decreasing height, being about 5.3×10^{-3} at 80 km, 7.9×10^{-1} at 70 km, and 1.0×10^{-1} at 60 km in a daytime condition. The effective loss rate estimated is shown to be consistent with the results derived from observations of solar eclipse, SID, and PCA events. (auth)

30439 EXCITATION OF THE OXYGEN GREEN LINE IN NIGHTGLOW AND AURORA. Henriksen, K. (Auroral Observatory, Tromsoe, Norway). Phys. Norv.; 7: No. 2, 57-64(1973).

The origin of the OI(5577)Å emission in nightglow and aurora has been examined, and it is concluded that several mechanisms can participate in the excitation process. Values of the different contributions are estimated, but due to the uncertainty in the reaction rate coefficients and the composition of the neutral atmosphere, these numbers must only be considered as indicative. (auth)

30440 AURORAL AUDIBILITY. Silverman, S. M. (Air Force Cambridge Research Labs., Bedford, MA); Tuan, T. F. Advan. Geophys.; 16: 155-266(1973).

The methodology and the use of anecdotal data are considered together with observations by professionally trained observers, surveys, individual observations, hypotheses of auroral audibility, and the case for brush discharge and aurorally induced electric fields. The characteristics and analysis of auroral sound events are discussed, giving attention to the frequency of occurrence, the geographic extent, latitudinal dependence, seasonal dependency, diurnal variation, sunspot cycle dependency, questions of the correlation with magnetic activity, auroral characteristics, the weather, the effect of altitude and terrain, and effects on animals. (IAA)

30441 IONIZATION SOURCES OF UNSOUNDING ELECTRON CONCENTRATION BY SOLAR ECLIPSE DATA OF 2/25/1971. Serafimov, K. B.; Kazakov, K. M.; Gogosheva, T. N. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 11, 1469-1472(1973).

The electron density variations in the ionosphere during the partial eclipse of of Feb. 25, 1971 are considered. Data from the observatories at Sofia and Michurin were used. (WDM)

30442 EXPERIMENTAL STUDIES OF SPACE–TIME CHARACTERISTICS OF SDV SIGNALS. Shubova, R. S.; Shul'ga, V. F.; Yampol'skii, Yu. M. (Inst. of Radiophysics and Electronics, Kharkov). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 1, 43-51(1974). (In Russian).

The amplitude, phase, and phase difference variations are experimentally investigated at the path extended to 7500 km according to NAA station signals at the frequency f = 17.8 kc/s at the sites spaced at 50 and 140 km across and along the propagation direction. For the transient periods (day–night at the propagation path) the distribution of energy of phase and phase difference fluctuations at the frequencies $(1.39 \text{ to } 33.6)\cdot10^{-4}$ c/s and the dependence of the correlation coefficient on the distance between the reception points are obtained. The scale of the low ionospheric irregularities is determined from the comparison of experimental results with theoretical calculations in the given frequency range. (auth)

Magnetospheric Phenomena

Refer also to abstract 30395.

30443 (AD-762483) SOLAR-GEOPHYSICAL DATA FOR THE 14 TO 21 DECEMBER 1971 GEOPHYSICAL EVENT. Mullen, E. G. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 13 Mar 1973. 95p. (AFCRL-TR-73-160; AFCRL-SR-155). NTIS $6.75.

A collection of solar-geophysical data from the period 14 to 21 December 1971 is presented with emphasis on data recorded at polar cap stations, in particular, the AFCRL Geopole Observatory at Thule, Greenland. A general description of each experiment is given. (auth)

30444 (AD-762952) PITCH-ANGLE DIFFUSION OF RELATIVISTIC ELECTRONS IN THE PLASMASPHERE. Technical Report, June 1966–May 1973. Kuck, G. A. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jun 1973. 245p. (AFWL-TR-73-116). NTIS $3.00.

The lifetimes of particles trapped in the Earth's magnetic field are controlled by the different transport processes. Particles can diffuse across the magnetic field lines (i.e., radial diffusion) or along field lines (i.e., pitch-angle diffusion). Very few experimental determinations of the pitch-angle diffusion coefficients are available. This report experimentally evaluates the pitch-angle diffusion coefficients for $1.75 < \text{or} = L < \text{or} = 2.5$. The Russian high-altitude tests of October 28 and November 1, 1962 injected large numbers of relativistic electrons into the plasmasphere. These electrons were observed by scintillation spectrometers aboard an Air Force satellite. (GRA)

30445 (AD-770580) STUDY OF MAGNETOSPHERIC BOUNDARIES BY THE SIMULTANEOUS OBSERVATIONS OF SOLAR AND MAGNETOSPHERIC PARTICLES. Blake, J. B.; Vampola, A. L. (Aerospace Corp., El Segundo, Calif. (USA)). 21 Nov 1973. Contract F04701-73-C-0074. 30p. (SAMSO-TR-73-359). NTIS $3.00.

A study of magnetospheric boundaries was made employing simultaneous measurements of solar and magnetospheric electrons, protons, and alpha particles during the solar particle event of April 12, 1969. The instruments aboard the spin-stabilized satellite OV1-19(1969126C) provided large energy ranges, numerous energy channels, and detailed pitch-angle distributions electrons, 24 channels, 53 keV to 5.3 MeV; p, 20 channels, 185 keV to 130 MeV; alpha, 5 channels, 850 keV to 9.0 MeV). The 105 degree inclination of the OV1-19 gave boundary measurements at widely separated local times. (GRA)

30446 UPPER ATMOSPHERE DURING GEOMAGNETIC DISTURBANCES. Truttse, Yu. L. pp 5-22 of Polyarnye Siyaniya i Svechenie Nochnogo Neba. Krasovskii, V. I. (ed.). Moscow; Izdatel'stvo Nauka (1973).

The relation between the emission intensities of low-latitude aurora and different geomagnetic indices was examined. It was found that: $\lg I(6300) = \beta D_{st} + G$, where: I (6300) — intensity of oxygen emission 6300 Å; β and G — empirical factors. β is a function of geomagnetic latitude and varies from $2\cdot10^{-3}$ to $1.7\cdot10^{-2}$ for the latitudes 35 to 60°, respectively, whereas G expresses intensity variations I (6300) depending upon the solar activity. In 1957 to 1959 the value of G varied from 1.9 to 0.9. This relation allows for calculation of energy release in the red oxygen emission during low-latitude aurora at the night side from –60 to +60° geomagnetic latitude. During the aurora which took place on February 11, 1958 the total energy release in this emission within the above ranges was of the order of $5\cdot10^{23}$ ergs. Its planetary value should be considerably greater since 6300 emission at the day side and in the high-latitude regions was not taken into account in calculations. The energy release exceeds the energy generally assigned to the geomagnetic storms. On February 11, 1958 the value of D_{st} was as great as –409 γ. A similar value of D_{st} can be obtained by uniform filling of the magnetosphere with charged particles having a total energy of $1.7\cdot10^{23}$ ergs. The heat-up of the upper atmosphere is shown to be more distinctly connected with D_{st} rather than with A_p indices. Energy losses of the upper atmosphere due to downward thermal conduction during heavy geomagnetic storms are less than through oxygen 6300 Å. The upper atmospheric density linearly depends on the sum of AE indices for the preceding 10 hours and a nonlinear dependence on the solar radiation. High solar activity levels slow down the density increase. (auth)

30447 UPPER ATMOSPHERE AS A REGULATOR OF THE GEOMAGNETIC STORMS, SUBSTORMS, AND AURORAS. Krasovskii, V. I. pp 57-76 of Polyarnye Siyaniya i Svechenie Nochnogo Neba. Krasovskii, V. I. (ed.). Moscow; Izdatel'stvo Nauka (1973).

Geomagnetic storms, substorms, and aurorae are considered to be a function of two groups of independent or weakly dependent processes in the solar wind and in the upper atmosphere.

Spectroscopic studies of the aurora show that the exciting electrons and protons frequently penetrate separately into the atmosphere in adjacent regions. Electrons exciting the aurora, easily penetrate into the E region of the ionosphere. Their partner—protons are low-energy particles (usually only 500 ev), therefore, they cannot penetrate to the same depth. An adequate electrical conductivity between the precipitation regions of protons and electrons is necessary for the appearance of intensive aurorae and substorms. However such electrical conductivity can exist when the ionized atmosphere is shifted from the precipitation region of electrons to the precipitation region of protons. (WDM)

30448 SOME POLAR CAP FEATURES IN THE DISTURBANCES OF THE GEOMAGNETIC FIELD. Zaitszev, A. N.; Fel'dshtein, Ya. I. pp 96-103 of Polyarnye Siyaniya i Svechenie Nochnogo Neba. Krasovskii, V. I. (ed.). Moscow; Izdatel'stvo Nauka (1973).

Magnetic field variations in the polar cap under static conditions in the summer of IQSY are considered. Presence of DPC disturbances, typical of only the polar cap is shown. The disturbance amplitude remains significant even at $K_p = 0$. The single-vortex current system DPC is proved by consideration of the field vectors. Some morphological peculiarities of DPC disturbance flow have been discovered. (auth)

30449 MAGNETIC ACTIVITY IN ANTARCTIC DURING IQSY. Afonina, R. G.; Zhigalov, L. N. pp 104-113 of Polyarnye Siyaniya i Svechenie Nochnogo Neba. Krasovskii, V. I. (ed.). Moscow; Izdatel'stvo Nauka (1973).

Space-time regularities of r_H^Y-index of magnetic activity in the Antarctic was analyzed in the IQSY period. Observations of 13 stations at high latitudes of the southern hemisphere were used. Daily distribution of the magnetic activity (S_Δ) and the mean daily values of γ_H^Y were calculated for each season and for all the days and periods of $K_p = 0$; $K_p = 2$, and $K = 4$. The analysis was performed within the coordinates of corrected geomagnetic latitude Φ' and corrected geomagnetic time "t". The space-time regularities of the magnetic activity, obtained in the Antarctic for period IGY (1), and in the northern hemisphere for the IGY and IQSY period were confirmed. (auth)

30450 SOLAR PLASMA GEOMAGNETISM AND AURORA. Chapman, S. Documents on Modern Physics. New York; Gordon and Breach, Science Publishers, Inc. (1968). 148p.

This book is based on lectures given in July 1962 at the 12th session of the Les Houches Summer School of Theoretical Physics. Topics considered include geomagnetism and related phenomena, solar plasma in interplanetary space, mutual influence of the solar gas and the geomagnetic field, magnetic disturbance and aurorae, and the ring current and its DR field. (WDM)

30451 MOTION OF CHARGED PARTICLES IN THE EARTH'S MAGNETIC FIELD. Chamberlain, J. W. Documents on Modern Physics. New York; Gordon and Breach, Science Publishers, Inc. (1964). 39p. &4.95.

This book is based on lectures delivered at the Les Houches Summer School in 1962. Topics covered include the dipole problem, guiding-center theory of particle orbits, and hydromagnetic theory of drift motions. (WDM)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 31016, and 31056–31058.

Atomic and Molecular Properties

Refer also to abstracts 30475 and 31087.

30452 HeH^+: QUASIBOUND STATE SPECTRUM, EXPERIMENTALLY-DERIVED SPECTROSCOPIC CONSTANTS, AND PROPENSITY FOR ROTATIONAL EXCITATION VIA COLLISION. Bernstein, R. B. (Univ. of Texas, Austin). Chem. Phys. Lett.; 25: No. 1, 1-8(1 Mar 1974).

Observations of HeH^+ resonances (Schopman et al.) are "spectroscopically" analyzed, maintaining consistency with ab initio potential well characteristics. Experimentally-derived Dunham coefficients provide all bound and quasibound state energies, thereby predicting proton–He scattering (shape) resonances. Collision-induced quasibound states of HeH^+ arise mainly via $\Delta J = 1$ excitations. (auth)

30453 VARIATIONAL EXPECTATION VALUES AND PERTURBATION THEORY CORRECTIONS. Cohen, M.; McEachran, R. P.; Rotenberg, A. (York Univ., Toronto). Chem. Phys. Lett.; 25: No. 1, 14-20(1 Mar 1974).

The relations between the Delves variational procedure for calculating expectation values and Dalgarno's perturbation method based on an interchange theorem are investigated in general. Calculations on model one-electron systems suggest that direct calculation of nonvariational expectation values may yield more accurate results with less computational effort than either the variational or the perturbation method. (auth)

30454 HIGH RESOLUTION STUDY OF THE $(F\ F_2) = (^3/_2\ ^1/_2) - (^1/_2\ ^1/_2)$ hfs TRANSITIONS IN STORED H_2^+ MOLECULAR IONS. Menasian, S. C. Seattle; Univ. of Washington (1973). 65p. University Microfilms order No. 74-827.

Thesis (Ph.D.).

Techniques for studying the radio-frequency spectrum of trapped H_2^+ ions were improved, allowing the measurement of hyperfine transition frequencies with accuracies of a few Hz. As in previous experiments, the trapped ions become aligned as they are photodissociated by linear polarized light. In the present experiment a pulsed radio-frequency transition scheme is used; the pulse sequence is chosen so that a large change in sublevel populations occurs if the transition under study takes place. The measured hyperfine transition frequencies (corrected to zero magnetic field) for the transition $K = 1$, $I = 1$, $F_2 = ^1/_2$, $F = ^3/_2 \rightarrow ^1/_2$ in the vibrational states $v = 4$, 5, and 6 are 15.371407(2), 14.381513(2), and 13.413460(2) MHz respectively in agreement with earlier, less precise, values. (Diss. Abstr. Int., B)

30455 INVESTIGATION OF TECHNIQUES FOR THE PRODUCTION AND MEASUREMENT OF NUCLEAR POLARIZATION IN He-3 BY OPTICAL PUMPING. Hettmer, J. H. Bloomington, IN; Indiana Univ. (1973). 123p. University Microfilms Order No. 74-4677.

Thesis (Ph. D.).

The purpose of this investigation was to explore techniques for producing nuclear polarization in He-3 gas by optical pumping and for measuring parameters pertinent to optimizing the polarization process under various conditions, particularly those which would provide an improved source of polarized He-3 ions suitable for injection into a particle accelerator. A He-3 optical pumping system was constructed, including a light source, a continuous flow helium purifier and a 6-coil homogeneous field electromagnet. Polarization was measured by detecting changes in the absorption of resonance light by metastable atoms in the gas, continuously created by a weak electrodeless discharge in the polarizing cell. A method of monitoring the absorption by modulating the weak discharge was investigated in detail and found to be particularly useful under weak signal conditions. The effect of the optical thickness of the absorption cell on polarization measurements was investigated and found to be significant under conditions where the dominant relaxation mechanisms in the polarized gas are not related to weak discharge intensity and relatively strong discharges are therefore used. A simple scheme for measuring the effective optical thickness of the cell as a function of its absorption, and also of the effective spectral efficiency of the light source was employed. An independent method of measuring the effective average density of metastable atoms using NMR techniques was used in conjunction with the optical thickness results to obtain an effective absorption cross section for the metastable atoms. Theoretical predictions for the polarization rate based on these data gave good agreement with experiment. A cell with a capillary opening to permit limited mixing between polarized gas in the cell and nonpolarized gas outside the magnetic guide field was used to simulate the behavior of a flowing system, as would be the case for an ion source. Polarization was measured as a function of cell pressure and discharge intensity. A weak discharge excitation frequency of 80 kHz was found to degrade polarization seriously, as compared to an excitation frequency of 14 mHz, except at very low pressures. It is concluded that the major factor limiting polarization in these studies was the relatively low intensity of the light source used, and that with existing techniques a source of polarized ions of approximately 1 microamp intensity and with roughly 15 percent nuclear polarization should be possible. (Diss. Abstr. Int., B)

30456 MODEL CALCULATIONS FOR THE DENSITY OF STATES IN ACTINIDE METALS. Bisch, P. M.; Continentino, M. A.; Lopes, L. C.; Gomes, A. A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 21: No. 6, 101-134(1973).

The electronic structure of the actinides has been of increasing interest, especially the peculiar magnetic properties of these metals. This work gives a description of a three-band problem, a broad s band which overlaps high-density d and f bands. The one-electron propagators G^{ss}, G^{dd}, and G^{ff}, as calculated in the Hartree–Fock approximation, are first discussed. The method of Kishore and Joshi is extended to include the three-band model: the equation for the poles and hybridized band dispersion relations are taken up. The results obtained for homothetic bands and model density of states are presented; in particular, the implications of the mixings in the Stoner criterion are qualitatively discussed. The numerical results confirm, even in the presence of the broad s band, the role of the interorbital interaction V_{df} in the study of the magnetic properties of the actinide metals. (8 figures) (RWR)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

30457 MUONIUM SPIN RELAXATION IN ICE OF ORDINARY AND HEAVY WATER. Gurevich, I. I.; Meleshko, E. A.; Muratova, I. A.; Nikol'skii, B. A.; Roganov, V. S.; Selivanov, V. I. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 10, 357-359(20 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 10, 608-611(20 Nov 1973).

The relaxation rate λ of the muonium spin was measured in frozen H_2O and D_2O at 77°K. The values obtained for λ of ordinary and heavy water are 5.7 ± 0.9 and 2.0 ± 0.2 μsec, respectively. (auth)

Collision Phenomena

Refer also to abstracts 30452 and 30760.

30458 (BUP-59) SCALING LAW FOR PROTON IONIZATION CROSS SECTIONS FOR DIFFERENT TARGET ELEMENTS. Karmaker, R.; Kocbach, L. (Bergen Univ. (Norway). Dept. of Physics). Dec 1973. 17p. Dep. NTIS (U.S. Sales Only) $4.00.

The semi-classical impact parameter approximation for calculation of ionization by heavy charged particle impact is formulated in terms of special variables. In this way a new scaling law for the ionization cross sections is obtained. Available experimental data on K-shell ionization are discussed in the light of this scaling law. A comparison is made with the scaling law derived by Garcia from the binary encounter approximation model. (auth)

30459 (COO-3247-25) GENERALIZED OSCILLATOR STRENGTHS. Progress Report, July 1, 1973–July 1, 1974. Lassettre, E. N. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). 1974. Contract AT(11-1)-3247. 36p. Dep. NTIS $5.00.

Progress is described on research under Contract AT(11-1)-3247 and research still to be completed in the period July 1, 1973 to July 1, 1974. The research objectives defined in the original proposal were closely followed. The principal accomplishments during the period were: The introduction of a computer controlled

counting system with provision for automatic control and operation of the electron spectrometer currently in use. Electron scattering with excitation of singlet-triplet transitions for helium was studied during the year both to acquire information on collision cross sections and to test a general theory of the abnormally high cross sections for forward scattering found for certain types of transitions. A theoretically predicted minimum in the cross section (at zero scattering angle) was found in a study over the range 100 to 500 eV of the $1^1S \rightarrow 2^3S$ transition of helium. Abnormally high cross sections for singlet-triplet transitions at high kinetic energy are predicted when the orbital term symbol is unchanged on excitation. As a test of the theory the $X^1\Sigma^+ \rightarrow b^3\Sigma^+$ transition in CO was looked for and found at $\theta = 0°$ at both 200 and 300 eV thus confirming the theory. New electron scattering studies on both CO and CO_2 are described. A new method for the calculation of singlet-triplet energy differences from generalized oscillator strengths is described. (auth)

30460 (JINR-E7-7688) EXCITATION OF KX-RAYS BY BOMBARDMENT OF THICK SOLID TARGETS WITH 150 MeV Se IONS. Gippner, P.; Kaun, K. H.; Neubert, W.; Stary, F.; Schulze, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 20p. Dep. NTIS (U.S. Sales Only) $4.00.

The yield of Kx-radiation arising from the interaction of ^{136}Xe ions with the ^{41}Nb, ^{42}Mo, ^{45}Rh, ^{46}Pd, ^{48}Cd, ^{49}In, ^{50}Sn, ^{64}Gd, ^{65}Tb, ^{70}Yb, ^{73}Ta, ^{77}Ir and ^{78}Pt targets was measured using a Si(Li) detector. Under the assumption that the Kx-radiation was emitted only in a target layer of about 1 mg cm^{-2}, the absolute values of the cross sections $\sigma_{K\alpha}$ and $\sigma_{K\beta}$ were determined. The dependence of the cross section on the atomic number of the target material is discussed on the basis of the molecular orbital model. (auth)

30461 STUDY OF THE INELASTIC SCATTERING OF 40 keV ELECTRONS BY A (100) FACE OF MgO. Bovier, C.; Burggraf, C.; Goldsztaub, S. (Univ., Strasbourg). Compt. Rend., Ser. A, B; 277: No. 20, 599-601(19 Nov 1973). (In French).

The energy composition of the Kikuchi lines and bands observed in the reflection of 40-keV electrons from a cleavage face (100) of MgO was studied. It was shown that the losses found in the Kikuchi lines and bands are less than 600 eV. The energy composition of a Kikuchi band is identical to that of the background continuum between 0 and 600 eV; the composition of a line, on the other hand, exhibits enhanced small losses. (auth)

30462 REACTIVE SCATTERING OF IONS. Herman, Z.; Birkinshaw, K. (Ustav Fyzikalni Chemie a Electrochemie, Prague). Ber. Bunsenges. Phys. Chem.; 77: No. 8, 566-575(Aug 1973).

Studies of reactive scattering of ions have provided information on collision kinematics of chemical reactions of ions: on microscopic reaction mechanisms, on partitioning of energy in a chemical reaction, and on cross sections of these processes. Reactions can be investigated over a wide range of collision energies and thus the influence of translational energy on the course of a chemical reaction can be studied. Data on ion–molecule processes are of importance for kinematics of chemical reactions in general. Recent development in theory requires more detailed kinematic information to be obtained from experiments, namely data on CM-angular distributions, on relative translational energies of products, on internal states of products, and on cross sections and their dependence on collision energy. Valuable kinematic information can be obtained from nonreactive scattering and from electronic correlation studies. Experimental techniques and data handling procedures are reviewed. Examples of both direct processes and intermediate complex formation are discussed. (GE)

30463 ASSOCIATIVE IONIZATION REACTIONS OF ELECTRONICALLY EXCITED PARTICLES. Muschlitz, E. E. Jr. (Univ. of Florida, Gainesville). Ber. Bunsenges. Phys. Chem.; 77: No. 8, 628-632(Aug 1973).

The present state of knowledge of the mechanism of associative ionization reactions in gases is reviewed. Recent experiments employing molecular beam techniques for the study of these processes are discussed; in particular, the associative and rearrangement ionization collisions of rare gas metastable atoms in the rare gases, hydrogen, and water vapor. Measurements of cross sections for secondary collision processes of the ions formed by Penning and associative ionization are presented. (GE)

30464 PENNING IONIZATION. Niehaus, A. (Univ., Freiburg i. B.). Ber. Bunsenges. Phys. Chem.; 77: No. 8, 632-640 (Aug 1973).

A review is presented of recent experimental investigations dealing with the ionization of various atoms and molecules in collisions with metastable rare gas atoms. These investigations include absolute cross section measurements, mass spectrometric analysis of the ions formed, and electron spectroscopic analysis of the electrons ejected. The results are discussed in terms of a potential curve model for Penning ionization. The approximate validity of this description is shown to be supported by the experimental results. In the case of the ionization of molecules it is shown that the Penning process is vertical and in simple case leads to a population of vibrational states of the ion in accordance with the Franck–Condon transition probabilities. (GE)

30465 LONG-RANGE INDUCED DIPOLE MOMENT OF THREE INTERACTING ATOMS. Gray, C. G.; Lo, V. W. N. (Univ. of Guelph, Ont.). Chem. Phys. Lett.; 25: No. 1, 55-58(1 Mar 1974).

The long range part of the electric dipole moment $\mu(R_{12}R_{13}R_{23})$ of three interacting atoms is calculated as a power series in R_{ij}^{-1}. The terms of longest range are of the types $R_{12}^{-3}R_{23}^{-3}$, $R_{12}^{-4}R_{23}^{-5}$ and $R_{12}^{-3}R_{23}^{-3}R_{13}^{-1}$. An estimate is made of the density needed to observe experimentally infrared translational absorption in pure inert gases. (auth)

30466 USE OF GAUSSIAN BASIS FUNCTIONS IN FREDHOLM CALCULATIONS OF ELECTRON–ATOM AND ELECTRON–MOLECULE COLLISIONS. Schneider, B. (Los Alamos Scientific Lab., NM). Chem. Phys. Lett.; 25: No. 1, 140-142(1 Mar 1974).

A simple modification of the usual Fredholm procedure for the calculation of electron scattering cross sections is described which makes use of the properties of gaussian type orbitals. The difficulties associated with the evaluation of bound–free and free–free integrals of the hamiltonian are eliminated. The technique may be extended to the electron–molecule scattering problem quite easily and makes the calculation of electron–molecule scattering cross sections a practical procedure. (auth)

30467 COLLISION INDUCED DISSOCIATION OF IONS. Los, J. (Instituut voor Atoom en Molecuulfysica, Amsterdam). Ber. Bunsenges. Phys. Chem.; 77: No. 8, 640-647(Aug 1973).

The study of collision-induced dissociation by means of high resolution mass spectrometry has developed in recent years to a method which yields detailed information on the collisional dissociation of molecules. The method is based upon the phenomenon of Aston bands appearing in mass spectra. Introduction of a collision chamber in the drift region between ion source and magnetic analyzer localizes the place where collisional dissociation takes place, and offers the possibility to measure the doubly differential cross section for this process with respect to velocity and scattering angle of the charged fragment; integrated however, over all impact parameters. At the energies considered (keV range) these measurements then yield detailed information about the influence of angular position and internuclear distance on collisional excitation of molecules. The experimental results on collision-induced dissociation of H_2^+ and HeH^+ are discussed in connection with the existing theoretical approaches. It is shown that there is experimental evidence that the different mechanisms contribute to the collision-induced dissociation of these molecules. (GE)

30468 THEORETICAL STUDY OF THE VIBRATIONAL EXCITATIONS IN HIGH ENERGY ELECTRON–MOLECULE SCATTERINGS. Ray, P. P. Riverside, CA; Univ. of California (1973). 88p. University Microfilms Order No. 73-32,719.

Thesis (Ph. D.).

A phenomenological theoretical approach is proposed for the study of vibrational-rotational excitations of a diatomic molecule in its ground electronic state by charged particle impact at high energies. In this approach one considers these processes to be dominated by two leading physical mechanisms–large impact parameter collisions and small impact parameter collisions. An application of this approach, within the framework of Glauber formulation, is carried out for the case of electron-H_2 molecule scatterings. Numerical results are obtained for 0-1, 0-2 and 0-3 vibrational excitations of H_2 in the incident electron energy range of 45 to 5000 eV. Comparison with available experimental data is made and it is found that the overall structures of the angular distribution curves can be understood in terms of the distinct physical effects contained in this approach. Various aspects of this approach are investigated. In particular, relative importance of single and double scatterings is discussed. Comparison with other approaches is also made. (Diss. Abstr. Int., B)

30469 PRODUCTION OF ARGON L X-RAYS IN $Cl^+ \rightarrow Ar$ COLLISIONS. Fortner, R. J. (Lawrence Livermore Lab., CA); Oona, H. Phys. Lett.; 47A: No. 3, 267-268(25 Mar 1974).

High resolution L X-ray spectral measurements of $Cl^+ \rightarrow Ar$ collisions are used to determine the argon L x-ray production cross sections. (auth)

30470 ATOMIC COMPOUND STATES IN RARE GASES: BOUND-STATE ENERGIES. Foglia, C. (CNR, Parma, Italy). Phys. Lett.; 47A: No. 3, 249-250(25 Mar 1974).

Bound state energy of the compound states of the rare gases was computed in the Hartree-Fock approximation. Results obtained for neon and xenon well agree with the experimental data and their usual interpretation. Different behavior is shown by argon and krypton. (auth)

30471 BREMSSTRAHLUNG FROM ELECTRON–POLAR-MOLECULE COLLISIONS. Sodha, M. S.; Pal, B. P.; Ghatak, A. K. (Indian Inst. of Tech., New Delhi). Nuovo Cim.; 20B: No. 2, 262-272(11 Apr 1974).

30472 ONE-DIMENSIONAL MODEL IN e–H SCATTERING. Raju, S. B. College Station, TX; Texas A and M Univ. (1973). 74p. University Microfilms Order No. 74-1047.

Thesis (Ph. D.).

A one-dimensional model was designed to test the convergence of the variational method used in three-body Coulomb scattering. Using this model phase-shifts for e-H scattering in the elastic region were calculated as a function of incident electron energy. The usefulness of the complex coordinate rotation method in predicting the resonances and bound states was also studied. An asymptotic expansion for e-H scattering for this model is derived. A computer code calculating the expansion constants was written. A method of testing the use of Peterkop's asymptotic expansion describing ionization in the present model was proposed. (Diss. Abstr. Int., B)

30473 SIMULATION OF BACKSCATTERING. II. The Classical Isotope Effect. Hutchence, D. K.; Hontzeas, S. (Univ. of Saskatchewan, Regina, Can.). Nucl. Instrum. Methods; 116: No. 2, 229-236(1974).

Some initial results are presented for an investigation into the possible existence of a "classical" isotope effect in backscattering phenomena. The existence of the classical isotope effect is hypothesized because of the effect of particle mass on scattering and energy losses. Examples given are of hydrogen isotopes and helium isotopes in a copper monocrystal. The results support the existence of the classical isotope effect. (auth)

30474 SIMULATION OF BACKSCATTERING. I. Description of the Simulation Model and Program. Hutchence, D. K.; Hontzeas, S. (Univ. of Saskatchewan, Regina, Can.). Nucl. Instrum. Methods; 116: No. 2, 217-228(1974).

A Monte Carlo simulation program (BACKS) has been written in such a way as to be efficient for the generation of backscattering data for particle energies of approximately 1 keV to 2 MeV. The program is several thousand times as efficient as conventional programs in generating backscattering data at higher energies due to an information return analysis routine involving particle generation over selected sub-areas of the crystal face. The program takes into account energy losses and thermal motion. It allows for a nearly complete range of beam-to-crystal-face angles. Most crystal forms can be used as well as crystals containing several different kinds of atoms. The data output includes a depth of information distribution, energy loss spectrum, a number of collisions, distribution, and a backscattering pattern. Sample results of α-particles in a gold monocrystal are given. (auth)

Atomic Theory

Refer also to abstract 31618.

30475 (COO-2271-24) EFFECTS OF RETARDATION ON ELECTROMAGNETIC SELF-ENERGY OF ATOMIC STATES. Au, C. K.; Feinberg, G. (Columbia Univ., New York (USA). Dept. of Physics). 1972. 24p. Dep. NTIS $4.25.

The significance of retardation effects in photon emissions and absorption is emphasized in the calculation of self-energy. It is explicitly demonstrated that inclusion of such effects leads to a finite answer for the shifts of atomic energy levels in a nonrelativistic theory without cutoff. Ambiguities that exist in the mass renormalization in the non-relativistic approach are pointed out. Such ambiguities vanish from the relativistic theory. Explicit calculation is carried out in the case of hydrogen by utilizing the Coulomb Green's function. The advantage of the present approach in calculating self-energy shift in high Z hydrogenic ions is suggested. (auth)

30476 (IS-3342) VAMP: A LIBRARY OF FORTRAN PROGRAMS FOR SOLVING THE VIBRATIONAL SECULAR EQUATION FOR THE ANALYSIS OF POLYATOMIC MOLECULES. Pinter, T. G.; Orr, G. L. (Ames Lab., Iowa (USA)). Feb 1974. Contract W-7405-eng-82. 147p. Dep. NTIS $10.50.

Thesis.

A subroutine library is described which was written for the analysis of molecular spectroscopic data and the refinement of the molecular force field. The modularization of the program allows ease of use for various partial tests. The routines were written in full Fortran IV for implementation on an IBM 360/65. (auth)

30477 MODIFICATION OF ATOMIC ENERGY LEVELS BY TWO ROTATING RF FIELDS. Tsukada, N. (Mitsubishi Electric Corp., Amagasaki, Japan). Phys. Lett.; 47A: No. 3, 265-266(25 Mar 1974).

The modification of the energy levels for spin-½ system by two rotating rf fields is described. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

30478 (AD-769700) DISCONTINUOUS MAGNETOFLUID-DYNAMIC FLOWS. Final Scientific Report. Geffen, N.; Hameiri, E.; Lustman, L.; Libai, S. (Tel Aviv Univ. (Israel)). Jun 1972. Contract F44620-71-C-0115. 55p. (AFOSR-TR-73-1989). NTIS $3.50.

Three parts are included: a closed form, sharp estimate for the breakdown of an initially smooth one-dimensional, time-dependent flow with various applications; a way to find where and when shocks appear in multi-dimensional flows; an analysis of a magnetohydraulic analogy to plasma flow where the dependence of the breakdown point on the physical parameters is given as well as a family of similarity solutions of the flow equations formulated in lagrangian coordinates. The report is organized in three self-consistent parts, leading from a mathematical analysis of two independent variables (e.g., one spatial coordinate and time) through many variables (e.g., two and three space dimensions and time) to an application and further analysis and calculation of a specific axial magnetohydraulic flow simulating various aspects of plasma flows of possible use in technological applications. (GRA)

30479 ELECTRODYNAMICS OF AN INHOMOGENEOUS, TURBULENT CONDUCTING FLUID. Moskov, N. N. Magn. Gidrodin.; No. 3, 41-46(1973). (In Russian).

The problem on diffusion of a regular magnetic field $\bar{H}$ in a inhomogeneous (along one coordinate) MHD-turbulence is reduced to a problem of mathematical physics, that is, an equation for $\bar{H}$ is obtained and the boundary conditions are enumerated. The behavior of a regular magnetic field in the convective zone is considered. As a result of diffusion in this zone it turns out that magnetic fields extending in the vertical direction are dominant. (tr-auth)

30480 MOTION OF ELECTRICALLY CONDUCTING FLUID BETWEEN TWO DISKS IN CROSSED ELECTRICAL AND MAGNETIC FIELDS. Gorbachev, L. P.; Nikitin, N. V. Magn. Gidrodin.; No. 3, 133-136(1973). (In Russian).

The magnetic axial field B is homogeneous, while the radial electric field is proportional to the radius: $E_r = E_0 r$. The whole region of flow is subdivided into a nonviscous kernel and edge boundary layers. Calculation is carried out by a method of approximately taking into account nonlinear terms of the equation of motion. Induced magnetic fields are neglected. Expressions are obtained for the radial, axial and peripheral components of velocity over the whole spatial flow, and it is shown that at a given E_0 the angular velocity of rotation of the kernel attains a maximum value at a certain value of the magnetic axial field B. (tr-auth)

30481 PROBLEM OF FORMATION OF EDDY CURRENTS IN A MOVING PLASMA DURING A SHARP CHANGE OF MAGNETIC FIELD. Grigoriadi, A. K.; Emets, Yu. P.; Rashchepkin, A. P. Magn. Gidrodin.; No. 3, 53-58(1973). (In Russian).

In studying the flow of an ionized gas in a magnetic field, a full set of equations of magnetohydrodynamics must be solved, and this task is a difficult problem even with the use of numerical methods. Sometimes with sufficiently general assumptions about the flow conditions it is possible to find an analytical solution of that part of the system describing the distribution of electrical quantities in the flow. These solutions are important since they can be used directly to determine dynamic gas parameters without solving the whole set of equations. In order to investigate phenomena in zones of a sharp break in magnetic field, the analytical solution is sought on the assumption of two-dimensional processes with the use of a Riemann boundary problem for automorphous functions. A general solution is obtained, where the profile of current velocities is arbitrary, while the magnetic field and the accompanying physical characteristics of the plasma undergo an abrupt change. Estimates are given for the effect of eddy currents formed in zones of an abrupt change of magnetic field on the distribution of electric potentials and on power processes in MHD-channels. New interesting effects include: 1) an inhomogeneous spreading out of the flow in the initial zone of a channel leads to deflection of the plasma flow to the cathode and reflection from the cathode to the anode wall; this process along the channel length is repetitive in character, 2) at the exit zone of a channel during supersonic flow of a plasma there is formed a zone of subsonic flow. From these results it is possible to visualize the main electrodynamic processes in a plasma at its entrance into a magnetic field. (SJR)

30482 MAGNETOHYDRODYNAMIC VISCOUS FLOW INDUCED BY AN OSCILLATING DISK. Debnath, L. (East Carolina Univ., Greenville, NC). J. Math. Phys. Sci.; 6: No. 4, 351-359(1972).

A magnetohydrodynamic flow induced in an incompressible, electrically conducting and viscous fluid by the non-torsional harmonic oscillations of an infinite disk is studied in considerable detail. With the inclusion of the effects of finite conductivity, and viscosity, a general boundary value problem has been solved. Solutions for the velocity distribution and the induced magnetic field are obtained. It is shown that the corresponding solutions without viscosity can be recovered as special cases. The dissipation mechanisms and the characteristic properties of the flow have been investigated in some detail. (Indian Sci. Abstr.)

30483 INTRINSIC PROPERTIES OF STEADY MAGNETO-GASDYNAMIC FLOWS. II. Purushotham, G.; Sambasiv Arao, P. (Nagarajunasagar Engineering Coll., Hyderabad, India). Proc. Indian Acad. Sci., Sect. A; 40: No. 4, 471-474(1970).

The variations of flow parameters for plane hydromagnetic flows along the streamlines and their orthogonal trajectories have been studied, considering two systems of plane curves one related to the streamlines and the other to their orthogonal trajectories. (Indian Sci. Abstr.)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 31086.

Electromagnetic

30484 (AD-764197) NEUTRON FORM FACTORS FROM ELASTIC ELECTRON–DEUTERON SCATTERING RATIO EXPERIMENTS AT VERY LOW MOMENTUM TRANSFER. Berard, R. W.; Traverso, T. J. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1973. 99p. NTIS $7.00.

Thesis.

Measurements of the ratio of the elastic electron-deuteron scattering cross section to the elastic electron–proton scattering cross section were made for low momentum transfers. Augmented by the work of Topping these data span a range of (q^2) from 0.05 (fm^{-2}) to 0.50 (fm^{-2}). From these, the electric form factor of the neutron, (G_{En}), was extracted using three Lomon-Feshbach wave functions for the deuteron, (LF1, LF5, and LF15). Values of the slope of (G_{En}) versus q^2 were measured to be 0.0218 ± 0.0022 for LF1, 0.0220 ± 0.0022 for LF5, and 0.0185 ± 0.0022 for LF15. Although the data seem to prefer model LF15, all were found to be in agreement with the thermal neutron–electron slope of 0.0193 ± 0.0004. (GRA)

30485 (INS-J-143) POLARIZATION OF RECOIL PROTONS IN η-MESON PHOTOPRODUCTION AT 890 MeV. Ukai, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 21 Jan 1974. 42p. Dep. NTIS (U. S. Sales Only) $5.25.

Thesis. Submitted to Nagoya Univ., Japan.

The experimental result of the recoil proton polarization for the process $\gamma + p \rightarrow \eta^0 + p$ is reported. Recoil protons were detected by a magnetic spectrometer, and their polarization was measured by a special spark-chamber system using carbon plates as electrode. The η-meson events were confirmed by detecting decay photons with a lead-glass Cerenkov counter of total-absorption type in coincidence with the recoil protons. Fine details of the polarization data and their analysis are described. The values of recoil proton polarization are obtained as −0.15 ± 0.30 and 0.27 ± 0.25 at the CM angle 82.3° and 108.3°, respectively, at the incident photon energy k = 890 MeV. These values suggest that a sign change of polarization occurs at about 90° at this energy. Incorporating this polarization data and others with the differential cross section, a phenomenological analysis is made within a framework of the one-particle-exchange model. This analysis indicates that in addition to the S_{11}-resonance ($N^*(1535)$), a comparably large contribution of the D_{13}-resonance ($N^*(1520)$) is needed to explain the photoproduction of the η-meson from the proton. (auth)

30486 ELECTROMAGNETIC FORM FACTORS OF THE PROTON AT LOW FOUR-MOMENTUM TRANSFER. Borkowski, F.; Peuser, P.; Simon, G. G.; Walther, V. H.; Wendling, R. D. (Univ., Mainz). Nucl. Phys.; A222: No. 2, 269-275(1974).

Electron-proton elastic scattering cross sections were measured at low four-momentum transfers squared (q^2 from 0.13 to 2.15 fm^{-2}) at six different energies between 150 and 275 MeV. The electric (G_E) and magnetic (G_M) form factors of the proton were determined by Rosenbluth plots and independently by using analytical functions for the form factors to fit the cross sections. The electric form factor is found to deviate significantly from the dipole fit. From the slope of the form factor functions at $q^2 = 0$ the rms radii of the charge and the magnetic moment distribution were determined. The charge rms radius is found to be more than 10% larger than the value given by the dipole fit. (auth)

30487 DO MAGNETIC MONOPOLES EXIST. Considerations for Theory and Experiments. Recami, E.; Mignani, R. (Univ., Catania, Italy). Lett. Nuovo Cim.; 9: No. 12, 479-482(23 Mar 1974).

It was concluded that relativity does not predict the existence of (subluminal) magnetic monopoles, but it allows one to predict that superluminal (electric) charges do exist; that superluminal (electric) charges contribute to the electromagnetic field as (subluminal) magnetic monopoles were previously supposed to do to give to the Maxwell equations a completely symmetrical form; and that tachyonic (electric) charges are predicted by relativity to behave when interacting with an electromagnetic field as magnetic monopoles endowed with faster-than-light speed. (JFP)

30488 ALL THE WORLD'S A HADRON. CERN Cour.; 14: No. 2, 39-41(Feb 1974).

Recent results from electron–positron storage rings are described. It has been found that both the quark model and scaling are violated. (JFP)

30489 π^0 AND π^+ PRODUCTION WITH POLARIZED PHOTONS IN THE ENERGY RANGE 1 TO 2 GeV. Abrahamian, L. O. (Yerevan Physics Inst., USSR); Avakian, R. O.; Aganiants, A. O. Phys. Lett.; 48B: No. 5, 463-466(4 Mar 1974).

The asymmetry of π^0 and π^+ photoproduction from hydrogen was measured. The π^0-mesons were detected at 130° cms with E_γ ranged from 0.9 to 1.65 GeV, and the π^+-mesons at 40° cms with E_γ ranged from 0.9 to 1.2 GeV. The results agree with model predictions of single pion photoproduction in the resonance region using fixed-t dispersion relations. (auth)

30490 MAGNETIC MONOPOLE DETECTOR. Karlsson, L. (Royal Veterinary and Agricultural Univ., Copenhagen). Nucl. Instrum. Methods; 116: No. 2, 275-281(1974).

The results of a search for magnetic monopoles are presented. A new electromagnetic monopole detector has been built and used in the present search for magnetic monopoles of cosmic ray origin. This detector has made feasible the first electromagnetic real-time cosmic-ray search for isolated magnetic poles. At least one event that satisfies the instrumental criteria for being a magnetic monopole event was recorded during a four week operation of the detector. (auth)

Weak

30491 (COO-3071-35) OBSERVATION OF MUONLESS NEUTRINO-INDUCED INELASTIC INTERACTIONS. Benvenuti, A.; Cheng, D. C.; Cline, D.; Ford, W. T.; Imlay, R.; Ling, T. Y.; Mann, A. K.; Messing, F.; Piccioni, R. L.; Pilcher, J.; Reeder, D. D.; Rubbia, C. Stefanski, R.; Sulak, L. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1973. 16p. Dep. NTIS $4.00.

The observation of inelastic interactions induced by high energy neutrinos and antineutrinos in which no muon is observed in the final state is reported. A possible, but by no means unique, interpretation of this effect is the existence of a neutral weak current. (auth)

30492 TEMPERATURE DEPENDENCE OF THE RELAXATION RATE OF THE π^+-MESON SPIN IN FERROMAGNETS. Gurevich, I. I.; Klimov, A. N.; Maiorov, V. N.; Meleshko, E. A.; Nikol'skii, B. A.; Roganov, V. S.; Selivanov, V. I.; Suetin, V. A. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 9, 332-333(5 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 9, 564-565(5 Nov 1973).

The relaxation of the π^+ spin in iron and nickel was revealed by the attenuation of the muon precession in a transverse magnetic field. The temperature dependence of the damping rate of positive muon spin precession amplitude in magnetized iron and nickel samples is shown. (JFP)

30493 EXPERIMENTAL STUDY OF THE $\Delta S/\Delta Q$ RULE IN THE TIME-DEPENDENT RATE OF $K^0 \rightarrow \pi e \nu$. Niebergall, F. (CERN, Geneva); Regler, M.; Stier, H. H.; Winter, K.; Aubert, J. J.; De Bouard, X.; Lepeltier, V. Phys. Lett., 49B: No. 1, 103-108 (18 Mar 1974).

The time-dependence of the decay rate of initially pure K^0 into the final states ($\pi^-e^+\nu$) and ($\pi^+e^-\bar{\nu}$) was studied to investigate the validity of the $\Delta S/\Delta Q$ rule. In a sample of 4724 events no evidence for weak hadronic current with $\Delta S = -\Delta Q$ is found. The ratio of the $\Delta S = \Delta Q$ amplitude and the $\Delta S = \Delta Q$ amplitude is $x = (0.04 \pm 0.03) - i(0.06 \pm 0.05)$. (auth)

30494 ESTIMATE OF THE PROBABILITY OF $K^+ \rightarrow \mu^+\nu_\mu\gamma$ DECAY. Weissenberg, A. O. (Inst. for Theoretical and Experimental Physics, Moscow); Egorov, O. K.; Minervina, Z. V.; Pozharova, E. A.; Skachkov, S. V.; Smirnitskii, V. A.; Dayon, M. I.; Euschenko, V. A.; Krilov, S. A. Phys. Lett.; 48B: No. 5, 474-478(4 Mar 1974).

About 100 000 K^+-decays were observed in a magnetic spectrometer with streamer chambers. The estimation for the radiative decay $K^+ \rightarrow \mu^+\nu_\mu\gamma$, $R^{exp} = [W(K^+ \rightarrow \mu^+\nu_\mu\gamma)]/[W(K^+ \rightarrow all)] = (5.8 \pm 3.5) \times 10^{-3}$, at $E_\gamma \geq 9$ MeV was obtained and the ratio $R = [W(K^+ \rightarrow \pi^+\pi^0)]/[W(K^+ \rightarrow \mu^+\nu_\mu)] = 0.328 \pm 0.005$ was measured. (auth)

30495 MEASUREMENT OF THE CHARGE ASYMMETRY IN THE DECAYS $K_L^0 \to \pi^+ e^- \bar{\nu}$ AND $K_L^0 \to \pi^+ \mu^- \bar{\nu}$. Geweniger, C. (CERN, Geneva); Gjesdal, S.; Kamae, T.; Presser, G.; Steffen, P.; Steinberger, J.; Vannucci, F.; Wahl, H.; Eisele, F.; Filthuth, H.; Kleinknecht, K.; Lueth, V.; Zech, G. Phys. Lett.; 48B: No. 5, 483-486(4 Mar 1974).

The charge asymmetry in semi-leptonic K_L^0 decays was measured in a high statistics experiment using multiwire proportional chambers. The asymmetry $\delta = (N^+ - N^-)/(N^+ + N^-)$, where N^+ and N^- are the partial decay rates for $K_L^0 \to \pi^- l^+ \nu$ and $K_L^0 \to \pi^+ l^- \bar{\nu}$, respectively, is found to be $\delta_L^e = (3.41 \pm 0.18) \times 10^{-3}$ for the K_{e3} mode, and $\delta_L^\mu = (3.13 \pm 0.29) \times 10^{-3}$ for the $K_{\mu 3}$ mode. Assuming CPT invariance and the absence of $\Delta S = -\Delta Q$ transitions, these results lead to a value of the real part of the CP-violation parameter ϵ, $\mathrm{Re}\,\epsilon = (1.67 \pm 0.08) \times 10^{-3}$. (auth)

30496 NEW DETERMINATION OF THE $K^0 \to \pi^+\pi^-$ DECAY PARAMETERS. Geweniger, C. (CERN, Geneva); Gjesdal, S.; Presser, G.; Steffen, P.; Steinberger, J.; Vannucci, F.; Wahl, H.; Eisele, F.; Filthuth, H.; Kleinknecht, K.; Lueth, V.; Zech, G. Phys. Lett.; 48B: No. 5, 487-491(4 Mar 1974).

In a short neutral beam the proper time-dependence of the decay $K^0 \to \pi^+\pi^-$ was measured. This time structure exhibits the interference between the short- and long-lived states and is in agreement with the general expectations of the CP violation phenomenology. This experiment gives new and more precise measurements of the following three parameters: i) the decay width of the short-lived K_S component: $\Gamma_S = (1.119 \pm 0.006) \times 10^{10}\ \mathrm{sec}^{-1}$; ii) the modulus of the CP violating parameter η_+: $|\eta_+| = (2.30 \pm 0.035) \times 10^{-3}$; iii) the phase of η_+ as a function of the $K_S - K_L$ mass difference Δm: $\phi_+ = (49.4 \pm 1.0)^0 + [(\Delta m - 0.540)/0.540] \times 305^0$. The result of $|\eta_+|$ may be compared with the result of the foregoing letter on Re ϵ in the frame of the superweak model. Good agreement is observed. (auth)

Strong (Baryon-induced)

Refer also to abstract 30701.

30497 (BNL-18736) PROTON–PROTON ELASTIC SCATTERING AT LARGE MOMENTUM TRANSFER. Russ, J. (Brookhaven National Lab., Upton, N. Y. (USA)). Mar 1974. 9p. Dep. NTIS $4.00.

The physics interests in pp elastic scattering at ISABELLE energies is considered in light of ISR results. An experimental configuration for studying pp elastic scattering at $s = 160{,}000\ (\mathrm{GeV})^2$ and $1 \le t < 25\ (\mathrm{GeV})^2$ is described. (auth)

30498 (COO-1428-369) OBSERVATION OF INCREASING CHARGED MULTIPLICITY AS A FUNCTION OF TRANSVERSE MOMENTUM IN 28.5 GeV/c pp INTERACTIONS. Gutay, L. J.; Laasanen, A.; Stanfield, K. (Purdue Univ., Lafayette, Ind. (USA)). 1973. 13p. (CONF-730976-3; BNL-18175). Dep. NTIS $4.00.

From 4th international symposium on multiparticle hadrodynamics; Pavia, Italy (Sep 1973).

The mean charged multiplicity $\bar{n}_{CH}$ was measured as a function of transverse momentum $p_\perp$ of the forward proton in the reaction $p + p \to p + MM$ for five intervals of missing mass MM using the Multiparticle Argo Spectrometer System. An increase of $\bar{n}_{CH}$ for $p_\perp > 1$ GeV/c was observed. (auth)

30499 (COO-1428-370) CHARGED MULTIPLICITY ASSOCIATED WITH TRANSVERSE MOMENTUM OF A LEADING PROTON IN pp AT 28.5 GeV/c. Ramanujukas, A.; Anderson, E. W.; Fisher, G. P. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). 1973. 8p. (CONF-730841-2). Dep. NTIS $3.00.

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973).

The mean charged multiplicity $\bar{n}_{CH}$ as a function of transverse momentum $p_\perp$ of the forward proton in the reaction $p + p \to p + MM$ for five intervals of missing mass MM using the Multiparticle Argo Spectrometer System was measured. An increase of $\bar{n}_{CH}$ for $p_\perp > 1$ GeV/c was observed. (auth)

30500 (COO-3071-29) SEARCH FOR MASSIVE LONG LIVED PARTICLES IN ALUMINUM TARGETS IRRADIATED BY 300 GeV AND 400 GeV PROTONS. Frankel, S.; Frati, W.; Resvanis, L.; Yang, W.; Nezrick, F. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 11 Sep 1973. 28p. Dep. NTIS $4.50.

A directional gas Cherenkov counter, which employed six phototubes to sample Cherenkov light from single particles having a gamma greater than ~10 was used to achieve accidental rates of less than one per day if operated near targets with surface radiation levels of as high as 10^{+3} r/hr. The cosmic ray background measured by the apparatus was reduced to less than one per day by mounting our directional Cherenkov counter above the irradiated targets and facing toward the earth. Two searches of a few days duration, after bombardments at energies of 300 and 400 GeV with $>10^{16}$ protons at NAL, were made in four inch thick targets of aluminum, mounted just down stream from another aluminum target. No long-lived particles were observed with cross sections for production and capture of approximately less than a micro-micro barn in a lifetime range of a few to a few thousand hours. (auth)

30501 (INP-857) ABOUT SOME FEATURES OF THE ANGULAR DISTRIBUTIONS OF PARTICLES PRODUCED IN INTERACTIONS OF PROTONS WITH EMULSION NUCLEI AT 67 GeV AND 200 GeV. Jurak, A. (Institute of Nuclear Physics, Krakow (Poland)). Nov 1973. 15p. (In Polish). Dep. NTIS (U. S. Sales Only) $4.00.

Preliminary results on angular distribution of particles produced in collisions of 67 and 200 GeV protons in emulsion are presented. It was found, that the differential cross section for production of particles in the region $\ln \tan \theta/2 \gtrsim -2.1$ and $\ln \tan \theta/2 \lesssim 2.1$ in the laboratory and antilaboratory system respectively, are independent of energy in the limits of statistical error. The number of particles produced at $\ln \tan \theta/2 \gtrsim -2.1$ depends linearly on the number of heavily ionizing particles. These characteristics are in favor of models in which the particles arise from the decay of a long-lived intermediate state. (auth)

30502 (JINR-E1-7669) LOW ENERGY Ap SCATTERING. Shakhbazyan, B. A.; Timonina, A. A.; Kalinina, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 10p. (CONF-730642-17). Dep. NTIS (U. S. Sales Only) $4.00.

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

It is shown that the enhancements observed in the Ap effective mass spectra may be due to those in Ap elastic scattering cross sections. (auth)

30503 (LBL-2144) PHYSICS RESEARCH WITH HIGH-ENERGY HEAVY IONS. Steiner, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 82p. (CONF-730991-1). Dep. NTIS $6.25.

From Adriatic meeting on particle physics; Rovinj, Yugoslavia (23 Sep 1973).

Lectures are given on heavy ion reactions at several GeV to relativistic energies. Experiments with heavy ions, types of theoretical approaches to high energy heavy ion interactions, experimental results, and other physics experiments and their potential significance are covered. (JFP)

30504 (TLU-13-73) EXCITATION FUNCTION FOR THE d(p,2p)n REACTION FOR $8.5 \le T_p \le 11.6$ MeV. Sundqvist, B.; Johansson, A.; Amten, L.; Glantz, L.; Goenczi, L.; Koersner, I. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Apr 1973. 29p. Dep. NTIS (U. S. Sales Only) $4.50.

Correlation cross sections for the d(p,2p)n reaction were measured in a kinematically complete experiment for twelve incident proton energies. The detector angles were fixed at $\theta_3 = \theta_4 = 30.0^0$; $\varphi_3 = 0.0^0$ and $\varphi_4 = 180.0^0$ throughout the experiment. Data were parameterized with a cutoff radius in the MSIA (modified simple impulse approximation) model. Weak indications of a cross section enhancement at about 10.0 MeV were found. The experimental data were compared with a separable potential model calculation of the excitation function. (auth)

30505 ANTINUCLEON PRODUCTION IN COLLIDING e^+e^- BEAMS AT SPEAR. Berk, D. (Univ. of California, Los Angeles); Buchanan, C.; Drickey, D.; May, C.; Shepard, P.; Stork, D.; Zdarko, R.; Dakin, J.; Seppi, E. Lett. Nuovo Cim.; 9: No. 12, 475-478(23 Mar 1974).

The results of an initial survey for antiproton and antineutron inclusive events produced by colliding electron and positron beams of 5.2 GeV center-of-mass energy are reported. The resulting upper limits are near the lower limit of the Bjorken–Kogut $\bar{p}$ branching fraction estimate and a factor of five larger than the simplest pure spacelike inversion estimate. (JFP)

30506 $\bar{p}p$ ELASTIC SCATTERING IN THE BACKWARD HEMISPHERE FROM 686 TO 1098 MeV/c. Burns, R. R.; Condon, P. E.; Mandelkern, M.; Price, L. R.; Schultz, J. (Univ. of California, Irvine). Nuovo Cim.; 20A: No. 3, 463-470(1 Apr 1974).

Differential cross sections are presented for $\bar{p}p$ elastic scattering for $\cos\theta_{c.m.} < 0$ at six laboratory momenta from 686 MeV/c to 1098 MeV/c. The data are dominated by the secondary diffraction peak which moves slowly to larger values of $|t|$ as the beam momentum increases. There is no evidence for a third diffraction peak or for direct-channel effects in these data. (auth)

30507 CLUSTERING PATTERNS IN HIGH ENERGY HADRON COLLISIONS. Ludlam, T. (Yale Univ., New Haven); Slansky, R.; Slaughter, J.; Dao, F. T.; Lach, J.; Malamud, E.; Schivell, J.; Poster, R.; Engelmann, R.; Kafka, T.; Pratap, M. Phys. Lett.; 48B: No. 5, 449-452(4 Mar 1974).

The event-to-event fluctuations of the rapidity distributions are analyzed for semi-inclusive data obtained from 205 GeV/c and 303 GeV/c proton–proton collisions observed at NAL. The results indicate the presence of clustering effects, with cluster sizes approximating those observed in the quasi-elastic events. The average cluster size appears to be independent of the multiplicity of the final state. (auth)

30508 INCLUSIVE π^0 SPECTRA AND CORRELATIONS IN 12.4-GeV/c PROTON–PROTON INTERACTIONS. Swanson, D. (Illinois Inst. of Tech., Chicago); Charlton, G.; Fu, C.; Glasser, R.; Jaeger, K.; Koetke, D.; Rubin, H.; Whitemore, J. Phys. Lett.; 48B: No. 5, 479-482(4 Mar 1974).

The inclusive reaction $pp \rightarrow \gamma$ + anything at 12.4 GeV/c was studied in the ANL 12-ft bubble chamber. From fitted $\pi^0 \rightarrow \gamma\gamma$ events, it is found that within errors π^0 decay is the only source of photons. The single γ distributions are transformed into inclusive π^0 differential cross sections and it is shown that for all momenta we are consistent with $2\sigma(\pi^0) = \sigma(\pi^+) + \sigma(\pi^-)$. From the multiple γ events we measure the π^0 correlation parameters f_2^{00} and f_3^{000}. (auth)

30509 PROPERTIES OF THE PHI-MESON AS OBSERVED IN $\bar{p}n$ ANNIHILATIONS AT REST. Bizzarri, R.; Ciapetti, G.; Dionisi, C.; Dore, U.; Gaspero, M.; Laakso, I.; Marzano, F. (Univ., Rome). Nuovo Cim.; 20A: No. 3, 393-400(1 Apr 1974).

Data on $\bar{p}n$ annihilation at rest into $\pi^-\varphi$ are presented. The production frequency, mass, width and decay angular distribution of the φ-meson are measured. (auth)

30510 $\bar{p}d$ INTERACTIONS AT 15 GeV/c. Raths, O. Hoboken, NJ; Stevens Inst. of Tech. (1973). 98p. University Microfilms Order No. 74-890.

Thesis (Ph. D.).

This investigation reports on 3408 four-prong final-state events resulting from the antiproton-deuteron interactions. The experimental data were obtained from 47,000 photographs taken of 15 GeV/c antiprotons incident on the Brookhaven National Laboratory 80-inch bubble chamber filled with deuterium. The following reactions were investigated: (1) $\bar{p} + d \rightarrow d + \pi^+ + \bar{p} + \pi^-$ and (2) $\bar{p} + d \rightarrow (p_s) + \bar{p} + p + \pi^-$. After corrections, the total cross section of reaction (1) was found to be 395 + 50 μbarns. The $\bar{p}d\pi^+\pi^-$ final state of reaction (1) was found to be dominated by Δ^{2-} (1236) production (σ_Δ = 200 ± 28 μb). A 2.2 GeV d^* enhancement, having a cross section of 106 ± 17 μb, was observed in the $(d\pi^+)$ invariant mass distribution. However, a significant forward-backward asymmetry in the d^* decay angular distribution prohibited a pure resonance interpretation of these events. After applying visibility and Glauber corrections, the total cross section of reaction (2) was found to be 672 ± 60 μb. Limited statistics (124 events) in the $pp\pi^-$ final state of reaction (2) prevented a systematic search for resonances in this channel. (Diss. Abstr. Int., B)

Strong (Meson-induced)

30511 (BNL-18572) ANALYSIS OF THE INTERACTION $K^-p \rightarrow \Sigma^0\pi^0$ IN THE 1575 TO 1750 MeV REGION. Chu, R. Y. L.; London, G. W.; Yu, Y. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 16p. (CONF-730943-13). Dep. NTIS $4.00.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

A formation type experiment made in a heavy liquid bubble chamber for the channel $K^-p \rightarrow \Sigma^0\pi^0$ in the 1575 to 1750 MeV cm energy range is considered. From the results containing ~⅓ of the statistics, essentially the total and differential cross sections for this channel are presented and compared with the results of a hydrogen BC experiment made by a CHS collaboration, where the $\Sigma^0\pi^0$ channel was studied indirectly. (auth)

30512 (BNL-18670) $K^-p \rightarrow \Sigma^0\pi^0$ CROSS SECTION BETWEEN 1575 AND 1710-MeV cm ENERGY RANGE WITH DETECTION OF GAMMAS. Chu, R. Y. L.; London, G. W.; Yu, Y. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 16p. (CONF-730477-1). Dep. NTIS $3.00.

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973).

A study was made, with good gamma detection, of the individual channels that contribute to the reactions $K^-p \rightarrow \Lambda$ neutrals in the K^- momentum range from 525 to 820 MeV/c. The $\Sigma^0\pi^0$ cross section is considered which is difficult to obtain without gamma detection (e.g. in a H_2 bubble chamber). Only events with all decay gammas detected are used for analysis. The results have direct bearing on the $\Sigma\pi$ branching ratios of the Λ(1670) and the Λ(1690). (JFP)

30513 (BNL-18671) $K^-p \rightarrow \Lambda^0\pi^0\pi^0$ and $K^-p \rightarrow \Sigma^0\pi^0\pi^0$ FORMATION IN THE 1570 to 1750 MeV C.M. REGION. Chu, R. Y. L.; London, G. W.; Yu, Y. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 12p. (CONF-730943-12). Dep. NTIS $3.00.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The results of an experiment designed to study the $K^-p \rightarrow \Lambda^0\pi^0\pi^0$ and $K^-p \rightarrow \Sigma^0\pi^0\pi^0$ formation channels in a heavy liquid bubble chamber are reported. These channels are impossible to observe directly by the hydrogen bubble chamber technique. Reaction cross sections for the two channels are presented. A comparison is made with cross sections of other relevant experiments. The fraction $Y^*(1385)\ \pi^0$ and $\Lambda(1405)\ \pi^0$ is calculated on their respective Dalitz plots. (auth)

30514 (COO-1195-281) CERN–IHEP IN OUR UNDERSTANDING OF THE $(3\pi^-)$ AND $(\bar{K}\pi\pi)^-$ STATES. Ascoli, G. (Illinois Univ., Urbana (USA)). 1974. 3p. (CONF-740408-1). Dep. NTIS $3.00.

From 4th international conference on experimental meson spectroscopy; Boston, Massachusetts, USA (26 Apr 1974).

Research on π + p and K + p interactions studying the $(3\pi^-)$ and $(\bar{K}\pi\pi)^-$ states is summarized. (JFP)

30515 (COO-1428-344) STUDY RARE DECAYS OF MESONS USING THE OMEGA SPECTROMETER. Ghidini, B.; Navach, F.; Palano, M. (Purdue Research Foundation, Lafayette, Ind. (USA)). 3 Oct 1973. 14p. Dep. NTIS $4.00.

It is proposed to use the Omega Spectrometer to obtain 2×10^6 events of final states involving a K^- or $\bar{p}$ for π^- + p interactions. Problems in meson spectroscopy are to be studied. (JFP)

30516 (COO-1428-373) PROPOSAL TO STUDY SOME RARE PION AND KAON INDUCED REACTIONS USING THE 40" RAPID CYCLING SYSTEM. (Stanford Linear Accelerator Center, Calif. (USA)). 18 Feb 1974. 32p. Dep. NTIS $4.75.

The 40" hydrogen bubble chamber is used in a triggered mode to obtain a ten to thirty times increase over current data in a few specific reactions with incident π^+ and K^- mesons. These reactions are $\pi^+p \rightarrow \Delta^{++}K^+K^-$, $\Delta^{++}p\bar{p}$, $pp\bar{n}$, pK^+K^0, $Y^*K^+\pi^0$, $Y^*K^+\pi^+\pi^-$, and $K^-p \rightarrow \Lambda 0 \rightarrow Y^*0 \rightarrow$ Search for the 0(1820) $\rightarrow Yg \rightarrow Y^*\pi^-$. This will allow a study of the rare decay modes of meson resonances which one can combine with the high statistics study of pion decays. There will be many quasi two-body channels where production characteristics and joint decay correlations will give further insights into the dynamics of strong interactions. (auth)

30517 MEASUREMENT OF POLARIZATION IN $\pi^-p \rightarrow K^0\Lambda^0$ AT 5 GeV/c. Ward, C. E. W.; Ambats, I.; Lesnik, A.; Meyer, W. T.; Rust, D. R.; Yovanovitch, D. D. (Argonne National Lab., IL). Phys. Lett.; 48B: No. 5, 471-473(4 Mar 1974).

The Λ^0 polarization was measured in $\pi^-p \rightarrow K^0\Lambda^0$ at 5 GeV/c, using a data sample of 3709 events. The polarization is positive for small t, passes through zero near $t = -0.3$ (GeV/c)^2, and becomes large and negative at larger t, consistent with a value of −1.0 for t between −0.7 and −1.6 (GeV/c)^2. (auth)

30518 SIMULTANEOUS PRODUCTION OF K^{*0}(892) AND Δ^{++}(1236) IN THE REACTION $K^+p \rightarrow K^+\pi^+\pi^-p$ FROM 4.3 to 5.0 GeV/c. Dehm, G. (Max-Planck-Institut fuer Physik und Astrophysik, Munich); Goebel, G.; Wittek, W.; Wolf, G. Nucl. Phys.; B71: No. 1, 52-81(1974).

The reaction $K^+d \rightarrow K^{*0}(892)\ \Delta^{++}(1236)n_s$ from a K^+d experiment with the CERN 2 m bubble chamber at 4.6 GeV/c is compared with the reaction $K^+p \rightarrow K^{*0}(892)\ \Delta^{++}(1236)$ from a K^+p experiment at the same energy. In addition, predictions of an absorption model, a Regge pole model and a quark model for the production and decay characteristics of the reaction $K^+p \rightarrow K^{*0}(892)\ \Delta^{++}(1236)$ are tested with the combined statistics of the K^+d experiment and three K^+p experiments between 4.3 and 5.0 GeV/c. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 31124.

30519 (ANL/HEP-7404) EQUIVALENT EXCLUSIVE AND INCLUSIVE MULTIPERIPHERAL DESCRIPTIONS. Pinsky, S. S.; Thomas, G. H. (Ohio State Univ., Columbus (USA). Dept. of

Physics; Argonne National Lab., Ill. (USA)). Jan 1974. Contract AT(11-1)-1545. 40p. (COO-1545-136). Dep. NTIS $5.00.

It is shown that for each exclusive model satisfying a multiperipheral principle, there is an inclusive model satisfying a multiperipheral principle which predicts the same values for all exclusive and inclusive differential cross sections. The converse statement is also true. The relation between these models is thus one to one: formal expression is given for the transformation between one model and the other. These expressions have the form of the nonrelativistic Lippman–Schwinger equation. The proof is given first for multi-Regge models having poles and cuts as the J plane singularities. It is then generalized to models with multiparticle thresholds. The physical origin of such thresholds is discussed. Also treated are the further generalizations of the proof to models having N quantum number channels and to models having any general multiperipheral structure. (auth)

30520 (DESY-74-3) ALTERNATIVES TO THE VENEZIANO AMPLITUDE. Weimar, E. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jan 1974. 26p. Dep. NTIS (U. S. Sales Only) $4.50.

Alternatives to the Veneziano amplitude are studied from a mathematical point of view within the framework of dual resonance models in the zero-width approximation for scalar particles without internal quantum numbers. (auth)

30521 (IC-73-194) CURRENT ALGEBRA AND LIGHT CONE (LECTURE NOTES). Furlan, G.; Paver, N. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1973. 100p. Dep. NTIS (U.S. Sales Only) $8.00.

A review is given of results based on a larger and larger abstraction to the real world of algebraic properties of the quark model. A reappraisal and reformulation of current algebra at infinite momentum is given. (JFP)

30522 (ITF-73-165-P) MELLIN POLES AND STRUCTURE FUNCTIONS. Kozyrskii, V. G. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The behavior of the structure functions in Bjorken region (complex and real value cases of the scaling variable) is studied using Mellin transform techniques. (auth)

30523 (JINR-P2-7710) EQUAL TIME COMMUTATOR IN THE MATRIX ELEMENT $\langle 0|[A_\mu^{+12}(x), A_\nu^{-12}(0)]|\rho^0(p,\lambda)\rangle$ AND LOCALITY. Fakirov, D. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Using the explicit form of the local spectral function $L_{\mu\nu}(q;p,\lambda)$ for the matrix element $\langle 0|[A_\mu^{+12}(x), A_\nu^{-12}(0)]|\rho^0(p,\lambda)\rangle$ obtained previously one goes to equal time commutator $[A_0^{+12}(x), A_\nu^{-12}(0)]\delta(x_0)$ belonging to the Gell-Mann's current algebra by an integration on q^0. All the possibilities of integration for fixed Lorenz indices are considered. As a result a number of sum rules are obtained on the ground of definite suppositions about the nature of the operator gradient terms and current algebra relations. A comparison with some results obtained in the earlier work by Dahmen, Rothe, Schillke is made. (auth)

30524 (NP-19969) EIGHTH ANNUAL REPORT, 1972. (International Centre for Theoretical Physics, Trieste (Italy)). 1972. 64p. Dep. NTIS (U. S. Sales Only) $6.25.

A summary of research on solid-state, high energy, and nuclear physics is given. A list of publications is included. (JFP)

30525 SUBATOMIC PHYSICS. Frauenfelder, H.; Henley, E. M. Englewood Cliffs, NJ; Prentice-Hall, Inc. (1974). 568p. $16.50.

The topics cover the instruments used, particles and nuclei, symmetries and conservation laws, interactions, models, and nuclear science and technology. (JFP)

30526 WAVE FUNCTIONS OF THE PARTON MODEL. Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 10, 380-383 (20 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 10, 650-654 (20 Nov 1973).

It is shown that the scaling of the cross sections of deeply inelastic processes means that the partons are localized in a three-dimensional Euclidean r-space that is the Fourier transform of the rapidities. The onset of scaling is determined by the form of the wave function of the hadron in this space. (auth)

30527 EFFECTS OF BRANCH CUTS ON THE CORRELATIONS BETWEEN CHARGED AND NEUTRAL PIONS. Levin, E. M.; Ryskin, M. G. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 18: No. 10, 383-385 (20 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 10, 654-657 (20 Nov 1973).

It is shown that the experimentally observed correlation between the number of charged and neutral pions, and also the scaling of Koba, Nielsen, and Olesen, can be attributed to the contribution of branch points. (auth)

Electromagnetic

30528 (DESY-73-64) QUASI-THREE-BODY e^+e^- ANNIHILATION. Hirshfeld, A. C.; Kramer, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1973. 53p. Dep. NTIS (U. S. Sales Only) $5.75.

The helicity formalism for e^+e^- annihilation into three-body and quasi-three-body final states is presented. Expressions for the cross sections and angular distributions are derived in the one-photon-exchange approximation. For the process $e^+e^- \to \rho\pi\pi$ the results of calculations based on various low-lying exchanges and VMD assumptions for the form factors are presented. When two of the final state particles resonate the formalism allows one to study the reliability of the narrow-width approximation made in previous work, and to include certain interference effects previously neglected. (auth)

30529 (DESY-73-65) CONTRIBUTIONS OF MULTIPHOTON EXCHANGE IN EP DEEP INELASTIC SCATTERING. Bartels, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1973. 22p. Dep. NTIS (U. S. Sales Only) $4.25.

An attempt is made, within the light-cone approach, to estimate effects of multiphoton exchange in deep inelastic scattering. For the exchange of n photons in the Bjorken limit, contributions of the form $(\ln^2 Q^2)^{n-1}$ times the one-photon approximation are found. Under the assumption that they are the leading ones in each order, they can be summed up to a power-behaved function of Q^2 which modifies the structure functions $W_i(\nu,Q^2)$ in such a way that in the Bjorken limit they are no longer functions only of ω. A rough numerical estimate indicates that corrections due to multiphoton exchange become important (10% of the one-photon contribution) at about $Q^2 \sim 10^4$ GeV^2, but are always screened by the larger effect of radiative corrections at the electron vertex. They are, however, directly visible in $d\sigma(e^+p) - d\sigma(e^-p)$. (auth)

30530 (ITF-73-173-P) POLARIZATION PHENOMENA UNDER FAST ELECTRON SCATTERING BY DEUTERONS. Malyarzh, E. M.; Tartakovskii, V. K. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 12p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

The polarization of nucleons, which arise under deuteron electrodisintegration as the function of the angle between nucleon trajectories is considered. Under electron scattering by large angles the polarization is conditioned by the interaction in a finite state as well as the presence of D-wave in the deuteron ground state. It is shown that the polarization degree of producing nucleons essentially depends on the choice of radial parts of the deuteron wave function and the D-wave contribution into the deuteron ground state. (auth)

30531 (JINR-P3-7634) POSSIBLE EXPERIMENTAL STUDY OF DIRECT n–e COLLISIONS. Aleksandrov, Yu. A.; Matora, I. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 8p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

It is shown that at a modern level of engineering development the experiment with a sufficient set of statistics is practicable, by means of which the scattering of the electron beam on free neutrons can be studied. (auth)

30532 (JINR-P10-7681) STATISTICAL ANALYSIS OF $K \geq 2$ GAMMA-QUANTUM SYSTEMS ACCOMPANYING THE NUCLEAR INTERACTIONS AT HIGH ENERGIES. Slovinskii, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

An algorithm is described for an analysis of systems consisting of $k \geq 2$ γ-quanta and accompanying the nuclear interactions recorded on Xe bubble chamber picture. (auth)

30533 (LNF-73-60) QUARK MODEL PREDICTIONS FOR RADIATIVE DECAYS OF MESONS. Bramon, A.; Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 9 Oct 1973. 11p. Dep. NTIS (U. S. Sales Only) $4.00.

From simple quark model arguments and assuming a quadratic $\eta - \eta'$ mixing the radiative decays of the vector and pseudoscalar mesons are predicted in good agreement with experiments. The results strongly favor the new determination of the $\eta \to \gamma\gamma$ partial width. (auth)

30534 (LNF-73-61) FINITE DISPERSION RELATIONS APPROACH TO $\eta \to \pi^+\pi^-\gamma$ DECAY. Bramon, A.; Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 11 Oct 1973. 8p. Dep. NTIS (U. S. Sales Only) $4.00.

Finite dispersion relations are used to obtain $\Gamma(\eta \to \pi^+\pi^-\gamma) \simeq (41 \pm 16)$ eV. Through the known branching ratio $(\eta \to \pi^+\pi^-\gamma)/(\eta \to \gamma\gamma)$ one deduces $\Gamma(\eta \to \gamma\gamma) \simeq 310 \pm 120$ eV, in good agreement with the new determination of the $\eta \to \gamma\gamma$ partial width. (auth)

30535 (ORO-3992-137) ABSORBED MULTIPERIPHERAL-LIKE MODEL OF ELASTIC SCATTERING AND MULTIPARTICLE PRODUCTION IN HIGH ENERGY HADRON COLLISIONS. Chiu, C. B.; Wang, K. H. (Texas Univ., Austin (USA). Center for Particle Theory). 1973. Contract AT(40-1)-3992. 18p. (CPT-186). Dep. NTIS $4.00.

An overall picture for hadron collisions extracted from some of the recent extensive work based on the absorbed multiperipheral-like model with an independent emission parameterization is presented. This model accounts for a number of observed features in the multiparticle production and elastic scattering of pp collisions. The multiparticle data considered are: pion multiplicity distribution, pion and nucleon inclusive transverse momentum distributions and the moments of the inclusive longitudinal distribution. And the elastic data are: total cross section, ratio of the real part to the imaginary part of forward amplitude and differential cross section. (auth)

30536 (ORO-3992-174) UNIFIED THEORY OF WEAK AND ELECTROMAGNETIC INTERACTIONS WITHOUT SPONTANEOUSLY BROKEN GAUGE SYMMETRY. I. Hsu, J. P.; Sudarshan, E. C. G. (Texas Univ., Austin (USA). Center for Particle Theory). 1974. 12p. (CPT-218). Dep. NTIS $4.00.

A class of renormalizable and "unified" theories of electromagnetic and weak interactions is constructed without Higgs mesons and without spontaneously broken gauge symmetry. Lagrange multiplier fields are employed in the construction of these theories, starting from a Yang-Mills type Lagrangian whose isospin gauge symmetry is broken by mass terms. These mass terms may be chosen to violate even the global isospin transformations; one needs this generality to deal with massless photons and massive intermediate vector bosons within the same "unified" theory. The construction relies on a highly symmetric interaction structure (which is not shared by the total Lagrangian) to bring about renormalizability. The theory so constructed is renormalizable, covariant and asymptotically free. Once a family of fictitious particles with well specified interactions are introduced into the theory the S-matrix may be calculated using a set of simple Feynman rules and is seen to be explicitly unitary. In the definition of the Lagrangian of the interacting fields one has two free parameters α and ξ; the propagators and the vertices do depend on these parameters. The parameter α corresponds to a gauge change in the photon propagator; and ξ is the ratio of the square of the mass of the charged intermediate boson to that of its scalar counterpart so that the limit $\xi \to 0$ corresponds to infinitely heavy scalar quanta and a manifestly unitary S-matrix. (auth)

30537 UNIQUENESS OF THE DETERMINATION OF THE CURRENT COMMUTATORS FROM DATA ON DEEP INELASTIC SCATTERING. Ioffe, B. L. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 11, 391-395(5 Dec 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 11, 668-671(5 Dec 1973).

The limitations imposed on the general form of the ambiguities that arise when current commutators on the light cone are determined from data on deeply inelastic lepton production are indicated. The admissible types of ambiguities do not violate the sum rule of Gross and Llewellyn-Smith, but can lead to violation of the sum rule for the Schwinger term. (auth)

30538 EFFECTS OF LONG RANGE POTENTIALS ON THE SOFT PHOTON THEOREM AND ON INELASTIC THRESHOLD SCATTERING. Winter, S. A. New York; New York Univ. (1973). 74p. University Microfilms Order No. 74-1985.

Thesis (Ph. D.).

The effects of long range potentials on two independent problems that have previously been considered primarily only for short range potentials are investigated. The first concerns the soft photon theorem while the second concerns inelastic threshold scattering. The soft photon or Low theorem specifies the k^{-1} and k^0 terms of a power series expansion in the photon wave number, k, of the radiative bremsstrahlung transition matrix element associated with the process $A + B \to C + D + \gamma$ in terms of the nonradiative transition matrix element associated with the process $A + B \to C + D$. It is derived nonrelativistically and directly for the simple case of the scattering of a particle from a fixed potential, V(r). The assumptions of this derivation are examined to determine the applicability of the theorem to long range potentials asymptotic to r^{-n}; the assumptions include the possibility of expanding the off the energy shell T matrix elements about the on the energy shell T matrix elements. A sufficient condition is obtained for the validity of the Low theorem for all scattering angles, namely, $n > 3$. It is observed that on physical grounds this may possibly be improved in certain circumstances, such as excluding small angle scattering. Inelastic threshold scattering in the presence of a long range potential may be investigated using the two-potential formula. This approach, which is particularly useful for weak long range potentials, is simple, depicts all the physics of the phenomenon and leads to relatively uncomplicated calculations. Although the existence of an arbitrary number of open and closed channels can be assumed, for simplicity initially only the case of two open channels is treated. First and second order corrections in the strength of the long range potential to the K matrix elements are obtained. For a particular case of interest it is found that the dominant term of the normal Wigner behavior (for short range potentials) for nondiagonal K matrix elements remains unchanged although in second order the next term is non-Wigner and non-analytic. Finally it is noted that the methods formulated should be sufficient to determine the applicability of Wigner's rules in any particular instance essentially by inspection. (Diss. Abstr. Int., B)

30539 ANALYSIS OF PROTON AND PION ELECTROMAGNETIC FORM FACTORS. Cheung, S. C. Pittsburgh; Carnegie-Mellon Univ. (1973). 144p. University Microfilms Order No. 74-4716.

Thesis (Ph. D.).

A new technique is applied to analysis of the 2 physical quantities. This technique aims to improve the treatment of the following 3 problems: the model dependence preimposed to the analysis and the ambiguous truncation point of series expansions—both of which occur naturally in fitting data, and can cause serious bias in analysis—and thirdly, the instability caused by experimental errors. The proton and pion form factors are fitted with various physical constraints and are extrapolated to other domains e.g., in order to calculate charge radii, etc. Proton form factor data were directly collected from 15 experiments while pion form factor data were extracted from electroproduction cross section data using Chew-Low extrapolation. Relative renormalization of data between various experiments is also treated. (Diss. Abstr. Int., B)

30540 PULVERIZATION AND FRAGMENTATION MECHANISMS OF THE GLUON EXCHANGE MODEL. Hayashi, M. J.; Koretsune, S.; Tanaka, H. (Osaka City Univ.). Lett. Nuovo Cim.; 9: No. 8, 315-319(23 Feb 1974).

A model of fragmentation and pulverization mechanisms based on the light-cone formulation of the quark-gluon model is proposed for deep inelastic scattering. The model is applied to single-particle inclusive cross sections for eN and pp interactions. (LBS)

30541 REGGE-MUELLER VS. PARTON MODEL ANALYSIS OF DEEP INELASTIC REACTIONS. Chaichian, M.; Kitakado, S.; Lam, W. S.; Zarmi, Y. (Univ. of Helsinki). Nuovo Cim., 20A: No. 2, 233-259(21 Mar 1974).

The Regge-Mueller expansion of single-particle inclusive distributions in deep inelastic lepton-hadron scattering is matched with the $\omega \to \infty$ limit of the parton model description of the same reaction. Relations and inequalities among couplings and fragmentation functions, which appear also in purely hadronic reactions, are obtained. (auth)

30542 EQUIVALENT-PHOTON METHOD FOR INELASTIC SCATTERING OF ELECTRONS ON A PHOTON TARGET. Buchl, R. A.; Nigam, B. P. (Arizona State Univ., Tempe). Nuovo Cim., 20A: No. 2, 271-276(21 Mar 1974).

It is shown that the equivalent-photon method relates the cross-section for the inelastic process $e^- + \gamma \to e^- + X$ to the cross-section for real two-photon annihilation into hadrons. An estimate is given for this electroproduction cross-section by taking into account the resonance and diffractive regions for photon–photon annihilation into hadrons. (auth)

30543 CHIRAL BREAKING AND LOW ENERGY π^0 ELECTROPRODUCTION. Furlan, G. (Univ., Trieste, Italy); Paver, N.; Verzegnassi, C. Nuovo Cim., 20A: No. 2, 295-306(21 Mar 1974).

Threshold photo- and electroproduction of neutral pions off nucleons are analyzed in terms of the higher equal-time commutator $\langle N|[\partial^\nu A_\nu, V^{e.m.}]|N\rangle$, evaluated in the $(3,\bar{3}) \oplus (\bar{3},3)$ model of Gell-

Mann, Oakes and Renner. In particular the role of the chiral-symmetry-breaking parameters is discussed. Comparison with other, independent approaches leads to a size of the "proton-quark" mass consistent with the notion of approximate $SU_2 \times SU_2$ symmetry of hadrons. (auth)

30544 MULTI-PION PRODUCTION IN A CASCADE MODEL FOR e^+e^- ANNIHILATION. Craigie, N. S. (Univ., Hamburg); Rothe, K. D. Phys. Lett.; 49B: No. 1, 99-102(18 Mar 1974).

A generalization of the vector dominance model for e^+e^- annihilation is considered, in which multi-pion production is the result of a vector meson cascade involving the ρ and ω mesons. The corresponding coupled set of integral equations for the total and n particle cross sections are solved in the limit of large c.m. energy. Depending on the asymptotic behavior of the $\rho\omega\pi$ form factor, the solutions are able to accommodate a pion multiplicity increasing like the logarithm or some power α (including $\alpha = 0$) of the total c.m. energy, as well as a total cross section falling slower than point-like. (auth)

30545 ELECTROMAGNETIC PROPERTIES OF π-MESONS AT LOW ENERGIES. Terent'ev, M. V. (Inst. of Theoretical and Experimental Physics, Moscow). Usp. Fiz. Nauk; 112: No. 1, 37-82(Jan 1974). (In Russian).

A discussion is presented on the theoretical structure, and also the possibilities of experimentally studying the amplitudes of the interactions of π-mesons with photons at low energies. The possibility of measuring the lengths of $\pi\pi$-scattering in photon-pion transitions is noted. In processes with an odd number of π-mesons an explanation is given of the fundamental role of the amplitude of the $\pi^0 \to 2\gamma$-decay, which determines the form of all the more complex amplitudes. This fact is connected with anomalies in the axial flow entering into the weak interaction. In processes with an even number of π-mesons the radius and polarizability are figured as the main parameters. The polarizability is connected with the amplitude of the weak decay. 28 illus. 141 refs. (tr-auth)

30546 DYNAMICAL THEORY OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Englert, F.; Brout, R. (Univ. Libre, Brussels). Phys. Lett.; 49B: No. 1, 77-80(18 Mar 1974).

The gauge theory of unified weak and electromagnetic interactions is developed without the use of scalar mesons. It is shown that the Glashow–Weinberg scheme is unrealistic, but that a similar such scheme is possible if one includes two pairs of leptons, identified with e^-, ν_e and μ^-, ν_μ. (auth)

30547 ELECTROMAGNETIC CHERENKOV RADIATION FROM TACHYONS. Mignani, R.; Recami, E. (Univ., Catania, Italy). Lett. Nuovo Cim.; 9: No. 9, 362-366(2 Mar 1974).

Using the principles of duality and tachyonization, it is shown that a tachyon can emit Cherenkov radiation only in a superluminal medium, and namely when it happens to travel in the tachyonic medium with speed slower than the apparent light speed in that medium. It is concluded that previous experimental searches for tachyons were expected to fail, since founded on the wrong hypothesis that tachyons would always emit electromagnetic Cherenkov radiation, even in vacuum or in a bradyonic medium. (LBS)

30548 MAGNETIC MONOPOLES AND TACHYONS. Mignani, R.; Recami, E. (Univ., Catania, Italy). Lett. Nuovo Cim.; 9: No. 9, 367-372(2 Mar 1974).

The connection between magnetic monopoles and tachyons is shown, in the framework of extended special-relativity theory, by generalizing the Maxwell equations to superluminal sources. (LBS)

30549 NUCLEAR EFFECTS IN THE ANALYSIS OF THE RHO–ω MIXING FROM PHOTOPRODUCTION. Gregorio, M. A. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim.; 20A: No. 3, 437-451(1 Apr 1974).

The coherent photoproduction of the ρ-meson from complex nuclei is analyzed. By using an optical-model description of the process, the electromagnetic and nuclear $\rho-\omega$ mixing is considered in detail. A mixing parameter, describing the ratio $(\omega \to \pi^+\pi^-)/(\rho \to \pi^+\pi^-)$ for the amplitudes is derived in which the nuclear mixing parts are clearly exhibited. (auth)

30550 SUM RULES FOR FORWARD ELASTIC PHOTON SCATTERING Maximon, L. C.; O'Connell, J. S. (National Bureau of Standards, Washington, DC). Phys. Lett.; 48B: No. 5, 399-402(4 Mar 1974).

Relations between integrals over forward elastic photon scattering amplitudes, forward elastic cross sections and total cross sections are derived from dispersion relations. A new photon–proton interaction sum rule is derived and evaluated. (auth)

30551 W^0 EFFECTS IN INCLUSIVE e^+e^- ANNIHILATION. Budny, R.; McDonald, A. (Oxford Univ.). Phys. Lett.; 48B: No. 5, 423-426(4 Mar 1974).

A general parton model is used to formulate W^0 effects in inclusive e^+e^- annihilation. These effects are of the order 1% in the case of inclusive pion production at CM energies of 10 GeV with the Weinberg W^0. (auth)

30552 POSSIBLE DUALITY ASPECTS IN e^+–e^- ANNIHILATION PROCESSES. Konishi, K. I. (Scuola Normale Superiore, Pisa, Italy); Orsitto, F. Phys. Lett.; 48B: No. 5, 457-462(4 Mar 1974).

Consequences of duality in e^+–e^- → a hadron + anything, expressed by a finite mass sum rule, are obtained. A simple explicit solution of the sum rule is studied. (auth)

30553 PION-EXCHANGE MECHANISM IN THE INCLUSIVE REACTION $\gamma + p \to \pi^- +$ ANYTHING. Hidaka, K. (Tokyo Univ.); Hosoya, A. Progr. Theor. Phys. (Kyoto); 50: No. 5, 1666-1674 (Nov 1973).

The photo-induced inclusive reaction $\gamma + p \to \pi^- +$ anything is investigated in the beam fragmentation region on the basis of the Regge pole exchange model. It is shown that the π-Reggeon exchange mechanism reproduces both the absolute magnitude and the shape of the experimental cross section satisfactorily. This mechanism also well explains the observed azimuthal angular correlation between the produced π^- and the linear polarization vector of the incident photon. (auth)

30554 PARAFERMI MODEL OF LEPTONS. Ohnuki, Y. (Nagoya Univ., Japan); Kamefuchi, S. Progr. Theor. Phys. (Kyoto); 50: No. 5, 1696-1714(Nov 1973).

It is shown that a Dirac field which obeys the parafermi commutation relations for order 2 and satisfies only the locality condition of the weaker form leads to two species of particles with unequal masses. A consistent relativistic theory is formulated for such a field by assuming that observables take different forms in the even and odd sectors of the state-vector space. The theory is then applied to describing leptons. The μ-e universality is found to be a natural consequence of the formalism. A theorem is proved that if any one of the lepton, muon and electron numbers obeys a superselection rule, so do the other two as well. (auth)

30555 RADIATIVE CORRECTIONS TO G_V/G_μ IN SIMPLE EXTENSIONS OF THE SU(2) × U(1) GAUGE MODEL. Sirlin, A. (New York Univ., NY). Nucl. Phys.; B71; No. 1, 29-51(1974).

The radiative corrections of order α to the ratio G_V/G_μ are estimated in the framework of two simple hadronic extensions of the SU(2) × U(1) gauge model. One involves four quarks with integral charges; the other, three colored quartets. The results are remarkably simple: the corresponding results of the local V–A theory with the mass m_Z of the Z vector meson substituted for the cutoff Λ are recovered. A phenomenological analysis shows that for a large range of values of m_Z, these estimates are of the correct sign and order of magnitude to verify, on the basis of the present data, the universality of the weak interactions in the sense of Cabibbo. The SU(2) × U(1) model has an interesting consequence: by implying a big lower bound for m_Z, it gives rise in a natural manner to large corrections of order α. The role of the strong interactions in the treatment of the short distance behavior in these calculations is qualitatively discussed. (auth)

30556 GAUGE THEORIES AND THE PION MASS DIFFERENCE. Jones, D. R. T. (Oxford Univ.). Nucl. Phys.; B71: No. 1, 111-118(1974).

Calculations of the pion mass difference from gauge theories of weak and electromagnetic interactions using soft pion techniques are considered. A particular model (based on the gauge group SU(2) × SU(2) × U(1)) is discussed in which the pions appear as elementary fields. (auth)

30557 ELECTRON ANGULAR DISTRIBUTION IN $e^+e^- \to e^+e^-\gamma$ AT HIGH ENERGIES. Altarelli, G.; Stella, B. (Univ., Rome). Lett. Nuovo Cim.; 9: No. 10, 416-420(9 Mar 1974).

The angular distribution of the radiating electron or positron from the $e^+e^- \to e^+e^-\gamma$ interaction at small angles and in the ultrarelativistic limit is analyzed on the basis of Feynman diagrams. The qualitative features of the distribution are discussed. (LBS)

30558 ELECTROMAGNETIC FORM FACTOR OF NUCLEONS. Kaushal, R. S. (Ramjas Coll., Delhi). Lett. Nuovo Cim.; 9: No. 13, 506-508(30 Mar 1974).

The proton form factor obtained from the oscillator model for quark structure is corrected by assuming that the latter has similar electromagnetic structure as pions. The structure of the pro-

ton form factor thus obtained is expected to be valid up to sufficiently large values of the momentum-transferred squared. However, in the small-q^2 limit it agrees well with models used earlier to fit the experimental data. (JFP)

30559 ELECTRODYNAMIC PROCESSES IN COLLIDING BEAMS OF HIGH ENERGY PARTICLES. Gorshkov, V. G. (Ioffe Inst. of Tech., Leningrad). Usp. Fiz. Nauk; 110: No. 1, 45-75(May 1973). (In Russian).

A classification is given of the quantum electrodynamic processes at high energy. The classification is based not on the perturbation theory but on the character of the asymptotic behavior of the amplitudes and cross sections at high energy. A simple formula is described for the occurrence of amplitude asymptotic behavior of different processes in the form of intermediate states in crossed channels. A review is given of the theoretical results for processes with cross sections not decreasing with increase of energy. By means of a summation of the principal terms of perturbation theory orders twofold logarithmic asymptotic behavior of processes with cross sections decreasing with energy increase was obtained. (tr-auth)

30560 TESTING THEORIES OF CHIRAL SYMMETRY. Ng, W. C. New York; New York Univ. (1973). 67p. University Microfilms Order No. 74-1941.

Thesis (Ph. D.).

Various physical consequences of theories of chiral symmetry are investigated. Predictions of the symmetry are given for the meson electroproduction process at an on-shell kinematical point where unknown contributions are minimized. Sum rules are derived for the corrections. Then a sum rule is presented for the Σ term in meson-baryon scattering from the assumptions of Bjorken limit, precocious asymptopia, and finite-mass dispersion relations. The commutation relations of the gluon model are used as input for a numerical evaluation. Next the explicit canonical structure of the light-cone restriction of the commutator of the weak current with its divergence is considered in the interacting quark-gluon model quantized in the infinite-momentum frame. The implications on neutrino scattering are analyzed. W_4 and W_5 are predicted to scale nontrivially as $\nu^{-2}F_4(\omega)$ and $\nu^{-2}F_5(\omega)$, which provides a simple test of light-cone current algebra feasible in the near future. The Σ term for weak currents is deduced from a causal representation near the light-cone, and a correction is also made in the W_3-sum rule obtained by naive infinite momentum techniques. As a by-product improved derivations of the Adler neutrino sum rules are obtained. (Diss. Abstr. Int., B)

30561 DEEP INELASTIC ELECTRON-PROTON SCATTERING PROCESS IN THE INFINITE RESONANCE MODEL. Wilson, R. Hoboken, NJ; Stevens Inst. of Tech. (1973). 152p. University Microfilms Order No. 74-895.

Thesis (Ph. D.).

The proton electromagnetic inelastic structure functions are explicitly evaluated in Bjorken's scaling limit of the infinite resonance model using the most degenerate infinite dimensional unitary irreducible representation of the dynamical group 0(4,2) and from the Barut-Corrigan-Kleinert infinite component wave equation. From the associated conserved linear current the saturation part was excluded to obtain an indefinitely increasing mass trajectory. The calculation predicts good scaling behavior of the structure functions and other properties related to these functions. These functions also nicely satisfy the Callan-Gross relation. (Diss. Abstr. Int., B)

30562 WEAK-INTERACTION EFFECTS IN $\eta \to \pi^+\pi^-\gamma$. Herczeg, P.; Singer, P. (Carnegie-Mellon Univ., Pittsburgh, PA). Phys. Rev., D; 8: No. 11, 4107-4116(1 Dec 1973).

Parity-violating effects due to the strangeness-conserving nonleptonic weak interaction are studied in the process $\eta(X^0) \to \pi^+\pi^-\gamma$. The circular polarization and the parity-violating linear polarization are calculated in the framework of the Cabibbo theory by using a pole model for the strong and electromagnetic interactions. The isoscalar ($\sim\cos^2\theta$) and isovector ($\sim\sin^2\theta$) components of the weak Hamiltonian are found to give comparable contributions. The magnitude of the circular polarization is obtained to be $(1-5)\times 10^{-9}$ and the linear polarization, being dependent on final-state interactions, is smaller by nearly two orders of magnitude. In theories with a large isovector component in the weak nonleptonic Hamiltonian (theories involving neutral currents or second-class currents) the circular polarization can be larger, an estimate giving $(1-3)\times 10^{-8}$. (auth)

Weak

Refer also to abstracts 30857 and 31121.

30563 (JINR-E2-7638) GENERALIZED SUM RULES FROM LIGHT-CONE CURRENT ANTICOMMUTATORS. Moulin, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. Dep. NTIS (U. S. Sales Only) $4.25.

A generalization is made of a former paper devoted to an investigation of the consequences of the light-cone structure previously postulated for current anticommutators. New sum rules and high energy asymptotic constraints for the structure functions of the lepton-hadron scattering are derived from the diagonal and non-diagonal matrix elements of the anticommutators of the vector and axial-vector currents and their moments. (auth)

30564 (ORO-3992-173) UNIFIED THEORY OF WEAK AND ELECTROMAGNETIC INTERACTIONS WITHOUT HIGGS PHENOMENA. Deshpande, N. G.; Dicus, D. A.; Hsu, J. P.; Sudarshan, E. C. G. (Texas Univ., Austin (USA). Center for Particle Theory). 1974. 13p. (CPT-217). Dep. NTIS $4.00.

A renormalizable unified theory of weak and electromagnetic interactions with intrinsic rather than spontaneous breaking of the isospin gauge group is proposed. Such a theory is unitary and asymptotically free. (auth)

30565 PRODUCTION OF MASSIVE LEPTON PAIRS IN HADRONIC COLLISIONS. Thacker, H. B. Jr. Los Angeles; Univ. of California (1973). 103p. University Microfilms Order No. 73-32,080.

Thesis (Ph. D.).

The production of lepton pairs of large invariant mass in high energy hadronic collisions is studied. A general method for treating the typical phase space integrations that arise is derived and employed in subsequent model calculations. The general properties of annihilation models are discussed in an invariant context, the transverse momentum behavior being related to the strength of the cutoff in the invariant $(\text{mass})^2$ of the annihilating particles. The SU(3) properties of the quark annihilation model are investigated, and the cross section is related to deep-inelastic neutrino structure functions. A form of duality in the lepton pair $(\text{mass})^2$ is applied to relate lepton pair production to the inclusive production of low lying vector mesons. A model is studied in which the lepton pair is emitted by a bremsstrahlung process, and an interesting cancellation among the several graphs is seen to reduce the incident energy dependence of the cross section by one power of s. A technique is derived for exploring the light cone behavior of current products directly from momentum space by the introduction of a proper time parameter. This proper time representation is then used to derive the DGS representation as generalized to describe lepton pair production. It is shown that the transverse momentum behavior of the cross section is determined by the number of superconvergence sum rules the DGS spectral function satisfies. (Diss. Abstr. Int., B)

30566 W BOSON PAIRS, THEIR PHOTOPRODUCTION AND DECAY TO LEPTONS. Sathe, A. P. New York; Columbia Univ. (1973). 61p. University Microfilms Order No. 74-1514.

Thesis (Ph. D.).

The photoproduction of W pairs was studied obtaining explicitly the amplitudes for various spin states of the W's. It is found that total cross sections grow rapidly with energy of incident photon. Also for an assumed value of the anomalous moment of the W to be equal to one, the W bosons tend to be transversely polarized. Further, the leptonic decay of the W pair is calculated including the interference from different spin states of the two W bosons. The differential cross section with respect to the transverse component of the sum of the laboratory momenta of the two decay charged leptons is obtained. It is found that even for high values of this momentum component, the differential cross section decreases with increasing assumed mass of the W boson. (Diss. Abstr. Int., B)

30567 WEAK INTERACTIONS AND THE KALBFLEISCH-FOWLER MODEL OF HADRONS AND LEPTONS. Rosen, S. P. (Purdue Univ., Lafayette, IN). Nuovo Cim., 20A: No. 2, 288-294(21 Mar 1974).

Weak interactions are examined in a three-triplet model in which two triplets are leptons and the third is hadronic. Despite new muon decay modes, the Cabibbo relations between neutron, lambda and muon decay are preserved. Other properties are also discussed. (auth)

30568 NEUTRAL CURRENT IN QUARK-PARTON MODEL. Ezawa, Y. (Ehime Univ., Matsuyama, Japan); Senba, K.; Yano, T.; Noda, M. T. Lett. Nuovo Cim.; 9: No. 12, 471-474(23 Mar 1974).

Recently in a neutrino reaction experiment large cross sections due to the neutral current were observed. In order to incorporate the neutral current into weak-interaction theory, the quantities on

the neutral current were calculated using the quark (spin-½)-parton model and making the additional assumptions that the neutral-current interaction is described by the current–current type, the current is of V–A type, and the contributions from the neutral partons can be neglected. Cross sections for neutrino and antineutrino interactions with protons and neutrons are calculated. (JFP)

30569 BREAKDOWN OF SCALING IN DEEP INELASTIC NEUTRINO SCATTERING. Barger, V. (Univ. of Wisconsin, Madison). Phys. Lett., 49B: No. 1, 43-46(18 Mar 1974).

Quantitative calculations of non-scaling modifications to quark parton model predictions for ν and $\bar{\nu}$ deep inelastic scattering at NAL energies are presented. The scaling breakdown is parametrized by a form factor $G(Q^2) = (1 + Q^2/M_G^2)^{-1}$ with M_G associated with either massive gluons or weak interaction vector boson exchange. The NAL neutrino total cross-section and ν-distribution data are compatible with $M_G \sim 10$ GeV. If non-scaling corrections exist, the $\bar{\nu}/\nu$ total cross-section ratio grows with energy. Relative differential cross-section predictions with $M_G \sim 10$ GeV and $M_G = \infty$ are contrasted to identify non-scaling characteristics in $\sigma^{-1}\, d\sigma/d\nu$, $\sigma_t^{-1}\, d\sigma/dx$, and $\sigma_t^{-1}\, d\sigma/dy$. (auth)

30570 WEAK INTERACTION BASED ON THE THREE-TRIPLET MODEL. Simple Product of Charged Current. Katuya, M.; Fujii, K.; Tamura, S. I. (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto); 50: No. 5, 1675-1691(Nov 1973).

On the basis of the three-triplet model of hadrons, the structure of weak interaction constructed as charged current × charged current is investigated. The hadronic current is a linear combination of (8, 1), (1, 8) and (8, 8) components of SU(3)′ ⊗ SU(3)″, and the leptonic current is the usual one. General constraints are given under which weak interaction responsible for nonleptonic decays has no (27, 1) representation. As differences between the ordinary interaction (Cabibbo theory) and interaction considered here appear in the matrix elements of the hadronic current products, the properties of Adler-type and Gross-Smith-type sum rules for nucleon target and the nonleptonic interaction of ordinary hadrons are investigated. The following results are obtained: (1) Even if the (27, 1) vanishing condition is satisfied, the Adler sum rules for nucleon target can be obtained. (2) It is possible to construct H_W by the hadronic current which satisfies the closed-algebra and the (27, 1) vanishing conditions. (3) The Adler sum rules cannot be obtained if the (27, 1) vanishing and the closed-algebra conditions are imposed. (4) Under the (27, 1) vanishing condition, the Gross-Smith sum rules cannot be obtained. (The values of the Gross-Smith-type integral are larger in magnitude than the original ones.) (5) If the values of $\int_0^1 (F_2^{\nu p}(x) - F_2^{\bar{\nu} n}(x))dx/x$ is larger than that in the usual theory, the value of $\int_0^1 (F_2^{\nu p}(x) - F_2^{\bar{\nu} p}(x))dx/x$ is larger than that in the usual theory. It is discussed how to select various possibilities of weak interactions (the present model, our previous model and the Cabibbo theory). (auth)

30571 NEUTRINO PROCESSES IN A COMPOUND MODEL FOR THE NUCLEON. Altarelli, G. (CERN, Geneva); Cabibbo, N.; Maiani, L.; Petronzio, R. Phys. Lett.; 48B: No. 5, 435-439 (4 Mar 1974).

Deep inelastic (charged and neutral current) neutrino processes are analyzed using parton distributions obtained previously from eN inelastic reactions. Excellent agreement is found with existing data. Sizeable production of "charmed" hadrons is predicted in charged current processes at asymptotic energy. (auth)

30572 APPROACH TO ASYMPTOTIC FREEDOM IN NEUTRINO PRODUCTION AND ELECTROPRODUCTION. Bailin, D.; Love, A.; Nanopoulos, D. V. (Univ. of Sussex, Brighton, Eng.). Lett. Nuovo Cim.; 9: No. 13, 501-505(30 Mar 1974).

The recent discovery that non-Abelian gauge theories of the strong interactions possess an attractive fixed point of the renormalization group at zero coupling constant, which made possible a field-theoretic explanation of Bjorken scaling, and was previously applied to electroproduction and $e^+ + e^-$ annihilation logarithmic corrections is extended to include neutrino production. Attention is focused on the possibility that the strong interaction gauge group is the SU(3) group which acts on the color indices of three triplets of Gell–Mann–Zweig quarks. The moments of the structure functions are found. (JFP)

30573 RENORMALIZABILITY, GAUGE INVARIANCE, AND $\nu_e - \nu_\mu$ SCATTERING IN THE WEINBERG–SALAM MODEL. Borchardt, S. R. Boulder, CO; Univ. of Colorado (1973). 168p. University Microfilms Order No. 73-32,514.

Thesis (Ph.D.).

The amplitude for $\nu_e - \nu_\mu$ elastic scattering was calculated to fourth order in the R_ξ-gauge in the framework of the Weinberg-Salam model to verify renormalizability and gauge invariance. Regularization and renormalization of two-point spinor loop contributions are explicitly carried out, and it is shown that the relevant Ward-Takahashi identities are satisfied. Comparative comments on ξ-limiting procedure, R_ξ-gauge and U-gauge calculations are made. (Diss. Abstr. Int., B)

Strong (General)

Refer also to abstracts 30862 and 31097.

30574 (JINR-P2-7659) TWO-BODY PROBLEM IN ADIABATIC AND STRONG COUPLING. Solodovnikova, E. P.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 32p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.75.

The two-body problem of strong interaction is considered. The Bogolubov transformation is generalized for the case of two bodies so as to underline the inertia center motion and to describe the relative particle motion. (auth)

30575 (JINR-P2-7675) ALGEBRA OF CURRENTS AND CLASSIFICATION OF HADRONS. Dao Vong Dyk; Nguen Van Hieu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The realization of irreducible representations of algebra of SU(6) × SU(6) currents in linear spaces of asymptotic operators of creation and annihilation of particles and antiparticles at rest is investigated. In this approach the difficulties of the application of this algebra in the Hilbert space of state vectors was not encountered. The possibility of the classification of hadrons on the basis of irreducible representations of this algebra is considered. (auth)

30576 THEORY OF GRAVITY AND HADRONIC PHYSICS. Chela-Flores, J. (Instituto Venezolano de Investigaciones Cientificas, Caracas); Herrera, L. A. Lett. Nuovo Cim.; 9: No. 12, 487-491(23 Mar 1974).

The problem of applying the ideas of general relativity to hadrons and leptons is approached from the point of view of Einstein theory whose field equations are essentially a proportionality between the Einstein tensor and the energy–momentum tensor. (JFP)

30577 LEADING PARTICLES, ENERGY MOMENTUM CONSERVATION, AND THE APPROACH TO SCALING IN INCLUSIVE REACTIONS. Meunier, J. L. (Univ., Nice). Phys. Lett., 49B: No. 1, 55-60(18 Mar 1974).

It is shown that the leading particle effect is responsible, via energy-momentum conservation, for a $s^{-\frac{1}{2}}$ rise of the inclusive spectra at $y = 0$, corresponding in Mueller language to a secondary Regge singularity with intercept zero. (auth)

30578 NUMBER OF NEUTRAL PIONS AND FIREBALLS WITH QUARK QUANTUM NUMBERS. Csikor, F.; Montvay, I.; Niedermayer, F. (Eotvos Univ., Budapest). Phys. Lett., 49B: No. 1, 47-51(18 Mar 1974).

The prediction of fireball models that for fixed total pion number the neutral versus charged pion distribution is binomial is confronted with experiment. The agreement is very good with available data. This restricts coupling ratios in the statistical model for fireball decay to coincide with those of a simple quark model. (auth)

30579 ROLE OF ABSORPTION IN INCLUSIVE REACTIONS. Antoniou, N. G.; Papaioannou, G. M. (Democritus Nuclear Research Centre, Athens). Nuovo Cim.; 20A: No. 3, 508-520(1 Apr 1974).

The absorptive effects in inclusive reactions are studied by generalizing the strong-absorptive Regge-pole model from quasi-two-body reactions. It is conjectured that the radius of the interaction is a decreasing function of the missing mass and the consequences of this conjecture are discussed both in the triple-Regge limit and in the fragmentation region. (auth)

30580 IS THE QUARK MASS AS SMALL AS 5 MeV. Leutwyler, H. (Institut fuer Theoretische Physik, Bern). Phys. Lett; 48B: No. 5, 431-434(4 Mar 1974).

The constituent symmetry group U(6) is incorporated in the null plane quark model of mesons. The value $m_u = 5.4$ MeV, and the estimate $m_s = 125-160$ MeV are obtained for the masses of the non-strange and the strange quarks respectively. Some checks of the model in terms of meson mass formulas are given. (auth)

30581 POMERON COUPLINGS IN THE PRESENCE OF REGGEON LOOPS. Green, M. B. (Cavendish Lab., Cambridge, Eng.). Nucl. Phys.; B71: No. 1, 93-110(1974).

The effect of reggeon loop corrections to the five-point function in the double-Regge limit is examined. Using the Gribov reggeon calculus the reggeon triangle insertion in the double-Regge pole vertex is first discussed. This is seen to give rise to an inverse square root branch point in the plane of the azimuthal angle. Making specific smoothness assumptions constraints that require the vanishing of certain triple-Regge vertice are obtained. Possible implications for the Brower–Weis decoupling theorem are discussed. (auth)

30582 SCALING OF ASSOCIATED MULTIPLICITY AND A TEST OF SEMI-INCLUSIVE SCALING. Manakata, H. (Hiroshima Univ.). Lett. Nuovo Cim.; 9: No. 10, 411-415(9 Mar 1974).

It is shown that a simple scaling law proposed by Koba, Nielsen, and Olesen for semi-inclusive cross sections implies scaling laws of associated multiplicity and associated moments. Experimental data on the $p + p \rightarrow p +$ anything interaction at 28.5 to 303 GeV/c are used to test the scaling law. (LBS)

30583 PROBLEMS CONCERNING QUARKS IN STRONG INTERACTIONS. van Parija, J. Louvain, Belg.; Univ. Louvain (1973). 87p. (In French).

Thesis.

The use of the quark model in strong interactions is based on the idea that hadrons are constituents of fundamental cells. This model gives rise to certain difficulties. The constraints imposed by duality on the internal symmetries as well as the predictions for pionic decay of $L = 1$ baryons are studied in a phenomenological model of $SU(6)_W$ breaking. (JFP)

30584 CURRENT ALGEBRA AND UNITARITY IN MESON–MESON SCATTERING. Ford, P. G. Waltham, MA; Brandeis Univ. (1973). 84p. University Microfilms Order No. 73-32,387.

Thesis (Ph.D.)

The Ward identities of an arbitrary current algebra are used to construct all 4-point Green's functions connected to the vector and axial-vector currents. These 4-point functions are then separated, without approximations, into one-particle reducible and irreducible parts, appropriate to the currents and spin-zero mesons of the current algebra. In this construction no single particle approximation is made, nor is it assumed that vector currents need be conserved. The result provides a representation of the meson-meson scattering amplitude that explicitly satisfies all the constraints of the current algebra. In particular, it satisfies threshold theorems, crossing symmetry, and reduction to the usual tree approximation in the single particle approximation. Application is made to kaon-pion scattering, obtaining a representation of the scattering amplitude that is suitable for investigations of elastic unitarity. Similar results were obtained for pion-pion scattering in earlier work. This led to a unitarized pion-pion scattering amplitude. In that analysis a hypothesis was made concerning a certain "contact term" which proposed that it was small and predominately real. A representation of the pion-pion scattering amplitude is constructed in the linear sigma model so as to examine the validity of this hypothesis, which was previously justified only by intuitive arguments. It is shown that this hypothesis is satisfied to good approximation in perturbation theory without appeal to these earlier intuitive arguments, which lends further support to the unitarization scheme. (Diss. Abstr. Int., B)

Strong (Baryon No. = 0)

Refer also to abstract 30641.

30585 (DESY-74-2) COVARIANT PERTURBATION EXPANSION IN CHIRAL THEORIES WITH PIONS AND NUCLEONS. Daniel, M.; Horgan, R. R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jan 1974. 45p. Dep. NTIS (U. S. Sales Only) $5.25.

A covariant perturbation scheme is developed to give a coordinate independent perturbation expansion of the chiral invariant pion model with nucleons. On the mass shell the covariant approach is shown to be equivalent to the standard perturbation theory. (auth)

30586 (JINR-E2-7563) RELATIVISTIC MODEL OF COMPOSITE MESONS. Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. Dep. NTIS (U. S. Sales Only) $4.00.

Mesons are treated as composite states of fermions and antifermions, described by the Euclidean Bethe-Salpeter equation with a local potential having a finite distance singularity. The connection of such potentials with the exponentially infinite mass spectrum of resonances is discussed. For the simplest potential, $V = f^2(r^2 - a^2)^{-1}$ the pion equation is solved by using WKBJ-method and the parameters f, a and the fermion mass are estimated. (auth)

30587 (ORO-4317-37) INDICATIONS OF COMPOSITE STRUCTURE AT MEDIUM ENERGIES. Technical Report No. 74-064. Brayshaw, D. D. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Feb 1974. 12p. Dep. NTIS $4.00.

The assumption of an underlying composite structure for the hadrons is shown to possess interesting implications for $N-N$ and $\pi-\pi$ scattering at medium energies. Comparison of the resulting predictions with experiment suggests that such indications are indeed present in the data. (auth)

30588 ANALYTICITY OF THE FORWARD ELASTIC SCATTERING AMPLITUDE WITH RESPECT TO THE SQUARE OF THE SCATTERED-PARTICLE MASS. Geshkenbein, B. V.; Ioffe, B. L. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 10, 378-380(20 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 10, 646-649(20 Nov 1973).

It is proved on the basis of previous results that the function $T(\nu\sqrt{q'^2/q^2}, q^2, q'^2)$ (where $T(\nu, q^2)$ is the forward scattering amplitude) is analytic in q'^2 in the complex q'^2 plane with a cut $(0, \infty)$. It is shown that knowledge of the functions $w_i(\nu, q^2)$ at $q^2 < 0$, which describe the electroproduction process, makes it possible to reconstruct the forward scattering amplitude of a virtual photon with $q^2 > 0$. (auth)

30589 DUAL PROPERTIES OF STRANGENESS ANNIHILATION PROCESSES. Inami, T. (Rutherford High Energy Lab., Chilton, Eng.); Miettinen, H. I. Phys. Lett.; 49B: No. 1, 67-72 (18 Mar 1974).

The dual properties of strangeness annihilation processes are studied. Experimental evidence is presented for such processes building up a low-lying Regge singularity. Quark-diagram arguments suggest that this singularity is the exchange degenerate $f'-\varphi$ trajectory. The possibility of studying the factorization properties of strangeness annihilation processes using hyperon beams is pointed out. (auth)

30590 TRANSVERSE-MOMENTUM DISTRIBUTION IN THE CENTRAL REGION IN A PHENOMENOLOGICAL DUAL MODEL. Bebel, D.; Wambach, U. M. (CERN, Geneva). Nuovo Cim.; 20A: No. 2, 307-316(21 Mar 1974).

A phenomenological dual amplitude for double pomeron exchange is evaluated for the transverse-momentum distribution at $x = 0$. It shows an $\exp[-bp_\perp]$ dependence for low $p_\perp$ values and a subsequent flattening-off for larger $p_\perp$. The results are compared with ISR data. Some analogies to the statistical bootstrap model are discussed. (auth)

30591 PARTON–PARTON INTERACTION AND BACKWARD PEAK IN ELASTIC $\bar{p}-p$ (K^--p) SCATTERING WITH EXOTIC U-CHANNEL. Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 9: No. 8, 320-324(23 Feb 1974).

The possibility that the characteristic properties (backward peak and energy dependence of $d\sigma/d\mu$ at $\mu = 0$) of backward $\bar{p}$ p and K^-p scattering at high energy can be understood by a gluon exchange model is examined. (LBS)

30592 IS THE ETA PURE OCTET. Kenny, B. G. (Australian National Univ., Canberra). Lett. Nuovo Cim.; 9: No. 8, 197-300(23 Feb 1974).

It is shown that theoretical estimates of the $\eta \rightarrow 2\gamma$ and $\eta \rightarrow 3\pi$ decay rates support the view that the eta is a pure octet. It is remarked that the chiral-symmetry breaking schemes in which the symmetry-breaking term belongs to the $(3, \bar{3}) + (\bar{3}, 3)$ representation of $SU(3) \times SU(3)$ seem to imply that the X is decoupled from the eta leaving only an octet of pseudoscalar mesons. It is suggested that experiment can provide a test of the symmetry-breaking scheme by determining whether or not the η and the X do mix. (LBS)

30593 EXPERIMENTAL SYSTEMATICS OF PARTICLE LIFETIMES AND WIDTHS. Mac Gregor, M. H. (Univ. of California, Livermore). Nuovo Cim.; 20A: No. 3, 471-507(1 Apr 1974).

By comparing the lifetimes of the metastable ($\tau > 10^{-17}$ s) elementary particles with one another, it is found experimentally that these lifetimes occur both as ratios of 2 and as ratios of $\alpha = e^2/\hbar c$, with supposedly dissimilar particles grouped together, and with no experimental counterexamples. When short-lived ($\tau \sim 10^{-22}$ s) meson and baryon resonances are studied, it is found that the width is a key identification symbol. Grouping together resonances that have similar (narrow) widths, very accurate linear mass intervals are obtained. This mapping can be extended to include essentially all of the observed narrow-width meson and

baryon resonances in a comprehensive pattern. These results suggest a weak-binding-energy approach to elementary-particle structure. This is the same conclusion that emerges from a broad overview of the successes of the quark model. The empirical level spacings point to the existence of two basic mass quanta, a spinless quantum $\mu \simeq 70$ MeV and a spin-½ quantum S ≃ 330 MeV. Electromagnetic properties of nucleons also indicate the existence of the 330 MeV mass quantum. Reconciling a 330 MeV mass quantum S with a 939 MeV nucleon mass and a 1795 MeV $\bar{p}n$ bound-state mass suggests the Fermi and Yang formulation of the nucleon rather than the formulation of Gell-Mann and Zweig. The observed spectrum of narrow-width meson and baryon resonances can be reproduced by forming suitable combinations of the quanta μ and S. Broad-width resonances are interpreted as rotational excitations. Basis states $3 \equiv 3\mu$ and $4 \equiv 4\mu$, initially selected to account for observed level spacings in hyperon resonances, are shown to have significance with respect to strangeness quantum numbers and with respect to basic characteristics of baryon and meson resonances. These basis states can also be used to account phenomenologically for the observed factors of 2 and α in the lifetimes of the metastable resonances. The predictive power of the present linear systematics is illustrated in a "meson excitation tower" for narrow-width resonances. First published in 1970, this excitation tower is shown with separate groupings for the resonances that were identified in 1970 and for the resonances that have subsequently been identified. (auth)

30594 EVALUATION OF $\pi\pi \rightarrow N\bar{N}$ D-WAVES FOR $-25\mu^2$ LESS THAN OR EQUAL TO T LESS THAN OR EQUAL TO $4\mu^2$. Hahn, B. D. (Cavendish Lab., Cambridge, Eng.). Nucl. Phys.; B71: No. 1, 172-188(1974).

A Froissart-Gribov projection of πN phase shifts and Regge amplitudes is used to evaluate the $\pi\pi \rightarrow N\bar{N}$ scattering length at $t = 4\mu^2$, and partial waves for $-25\mu^2 \leq t < 4\mu^2$. The new value of the scattering length is 15% higher than a previous estimate made in the narrow width resonance approximation. The values for the partial waves are confronted with previous estimates and lower bounds. As a result, the latter become saturated near $t = 0$, but less restrictive near $t = 4\mu^2$. (auth)

30595 LOWER BOUND TO THE $\pi^0\pi^0$ S-WAVE SCATTERING LENGTH. Furmanski, W. (Jagellonian Univ., Krakow). Nucl. Phys.; B71: No. 1, 119-124(1974).

Starting from analyticity, unitarity and crossing symmetry of the $\pi^0\pi^0$ elastic scattering amplitude an inequality between the S- and D-wave scattering lengths (α_0 and α_2, respectively) of the form: $\alpha_0 > -23.5\sqrt{\alpha_2} = 141\alpha_2$ is derived. Using the phenomenological value of α_2 the lower bound to α_0 can be improved in this way. (auth)

30596 REGULARIZATION AND RENORMALIZATION OF NONLINEAR PION COUPLINGS. Barua, D. Detroit; Wayne State Univ. (1973). 93p. University Microfilms Order No. 73-31,692.

Thesis (Ph.D.).

A general procedure for the regularization of the nonlinear pion couplings is developed by introducing auxiliary fields with indefinite metric. The resulting formalism not only enables one to evaluate all divergent integrals in an unambiguous manner but the regularized interaction energy density is also free from the well known complications involving $\delta(0)$ terms that arise in the absence of regularization. As an application, investigation of the fourth-order pion-pion scattering is carried out, and it is shown that the elimination of divergences in the scattering matrix element requires the use of four counterterms. Two of these counterterms represent the conventional mass and coupling constant renormalizations, the third counterterm is reminiscent of the well known linear pseudoscalar pion-nucleon theory, while the fourth counterterm has an unfamiliar form. Our results do not single out any specific model of non-linear pion couplings as being superior to the others. (Diss. Abstr. Int., B)

30597 VARIATIONAL PRINCIPLE FOR BETHE-SALPETER EQUATION BOOTSTRAPS OF THE VECTOR MESONS. Kercher, J. R. Ithaca, NY; Cornell Univ. (1973). 129p. University Microfilms Order No. 73-31,826.

Thesis (Ph.D.).

A new variational principle is presented for application to the bootstrap problem of the type which uses the Bethe-Salpeter equation as its theoretical starting point. This work was motivated by the work of Cutkosky in which he uses the Bethe-Salpeter equation for a self-consistent vector meson model. The variational principle represents an improvement in this type of calculation in that nonlinear multi-dimensional integral equations do not have to be solved nor are solutions assumed. Instead one uses trial Bethe-Salpeter amplitudes in the variational principle, and one can determine the values of the coupling constants, cutoff parameters in the amplitudes, and the masses. The variational principle is stationary at the solutions of the bootstrap equations. The method presented uses the Bethe-Salpeter normalization equations as a side constraint on the variation. To circumvent the practical difficulties in achieving analytic solutions to the integrals in the variational principle, a model is used in which a Wick rotation was assumed. The bootstrap was solved in the case of an SU_3 isotopic triplet in three different models. In one model, scalar couplings were used; in a second model the vector couplings were approximated. The third model uses vector propagators and vector couplings linear in the four-momentum vectors. Solutions to these models were found and discussed. Proposals for further calculations are made and, in particular, the equations for the SU_3 vector meson octet are displayed for future work. (Diss. Abstr. Int., B)

Strong (Baryon No. = 1)

30598 (COO-2271-26) DETAILED PREDICTIONS FOR THE P-N STRUCTURE FUNCTIONS IN THEORIES WITH COMPUTABLE LARGE MOMENTA BEHAVIOR. Parisi, G. (Columbia Univ., New York (USA). Dept. of Physics). 1973. 6p. Dep. NTIS $4.00.

If strong interactions are described by nonabelian gauge theories, detailed predictions are obtained for the q^2 dependence at fixed ω of the difference of the structure functions of the proton and neutron. (auth)

30599 (IFVE-STF-73-61) ANALYSIS OF N-SCATTERING AND HIGH ENERGY BY THE METHOD OF DISPERSION RELATIONS. Solov'ev, L. D.; Shchelkachev, A. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 18p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

Several possibilities of bringing in agreement the latest Serpukhov measurements on $\pi^\pm p$ total cross sections and differential cross sections for $\pi^- p \rightarrow \pi^0 n$ charge exchange at zero angle with dispersion relations were investigated. (auth)

30600 (ITF-73-152-P) DISPERSION RELATIONS FOR AVERAGED AMPLITUDES. Sabad, E. P.; Lomsadze, Yu. M.; Agranovskii, B. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 11p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

Proceeding from the general properties of the forward πN-scattering amplitude established rigorously in the traditional axiomatic approaches dispersion relations are proven for such amplitude averaged over a finite test function. These dispersion relations, as distinct from the ones for the amplitude itself, are directly verifiable in experiment. (auth)

30601 (ITF-73-160-P) INTEGRAL RELATIONS WITH DAMPING FUNCTION FOR FORWARD SCATTERING AMPLITUDE. Agranovskii, B. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

A number of integral relations with damping function connecting the real and the imaginary parts of the forward FN scattering amplitude is obtained. These relations do not contain the integrals in the sense of principal value. They can be used for testing the analyticity of the amplitude, finite-energy and asymptotic as $E' \rightarrow \infty$ predictions of its behavior. (auth)

30602 (RL-74-17) INCLUSIVE REACTION $K^- p \rightarrow pX$ AT 14.3 GeV/c. Tovey, S. N.; Paler, K.; Shah, T. P. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Jan 1974. 18p. Dep. NTIS (U. S. Sales Only) $4.00.

The reaction $K^- p \rightarrow pX$ was measured at 14.3 GeV/c, in the fragmentation region of the target proton. The differential cross section is studied as a function of momentum transfer and missing mass squared. In the triple-Regge limit, it is consistent with the dominance of a MMP coupling at large t but it is possible that couplings of the type PPP and $\pi\pi P$ also contribute at small $|t|$ values. (auth)

30603 B PRODUCTION, A CASE FOR SEMILOCAL DUALITY IN REGGEON-PARTICLE SCATTERING. Sorensen, C. (Eidgenoessische Technische Hochschule, Zurich). Phys. Lett.; 49B: No. 1, 86-90(18 Mar 1974).

By means of a simple application of semilocal duality to reggeon-particle scattering, $B(1^+)$ production is related to $\eta(0^-)$ production and a satisfactory description, in absolute magnitude and in shape, of the process $\pi p \rightarrow Bp$ is obtained which has caused difficulties when attacked by other methods. (auth)

30604 LONG-RANGE POTENTIAL AND THE COMPOSITE NUCLEON. Agarwal, B. K. (Alahabad Univ., India). Lett. Nuovo Cim.; 9: No. 8, 294-296(23 Feb 1974).

It was previously suggested that a neutron may be regarded as a $(\pi^+\mu^-)$ composite system and the proton as a $(\pi^-\mu^+)$ composite system. It is shown that this simple composite system can be realized with a long-range two-neutrino exchange potential. The model allows the potential to be calculated in terms of simple box diagrams which give convergent contributions and do not involve any unobserved particle. It is found that $V_{(n)}/V_{(p)} = m_\nu/m_\mu << 1$, which shows that the proton is a relatively stronger bound state than the neutron. (LBS)

30605 ELECTROMAGNETIC PROPERTIES OF HADRONS IN A TWO-BODY COMPOSITE BARYON MODEL. Ono, S. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 2, 589-609(Aug 1973).

The radiative widths of hadrons and the resonance contributions to the π^0 photoproduction cross sections are calculated using the two-body composite model of baryons proposed by the present author. Reasonable results are obtained and they are compared with those obtained from the quark model. The main results are the following: (1) The E_2 amplitude of the $\Delta^+(1236) \to p\gamma$ process vanishes as in the quark model. (2) Moorhous' selection rule cannot be obtained. (3) The smallness of helicity $1/2$ amplitudes of the π^0 photoproduction processes through the second and third resonances can be explained. (auth)

30606 AMPLITUDE ANALYSIS OF πN BACKWARD SCATTERING AT 6 GeV/c AND THE PERIPHERALITY. Takahashi, Y.; Kohska, Y. (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 50: No. 4, 1334-1346(Oct 1973).

An amplitude analysis of πN backward scattering is performed at p_{lab} = GeV/c from the viewpoint of the peripherality (the dominance of peripheral waves). A functional form $A\exp(Bu')J_\nu(R\sqrt{-u'})$ is assumed for Im $\Delta_{+\pm}$ and Im $N_\pm$ where Δ and N denote $I_u = 3/2$ and $I_u = 1/2$ exchange amplitudes, respectively, and ++(±) denotes the final and initial nucleon helicities and corresponds to $\nu = 1$ ($\nu = 0$). The resultant Im N_{++} is shown to be consistent with the above Bessel function representation, too. The parameters B and R can be taken as $B \sim 1.5$ (GeV/c)$^{-2}$ and $R \sim 1$ fm commonly for Im Δ_{++} and Im N_{++}, of which values are consistent with those obtained previously by amplitude analyses of various meson-baryon scattering and photo-vector-meson production process in the forward region. The results for Δ_{3+} and N_δ are consistent with the Regge phase of Δ_δ trajectory for $u \gtrsim -0.15$ (GeV/c)^2 and of N_α trajectory for $u \gtrsim -0.6$ (GeV/c)^2, respectively. The spin rotation parameters for $\pi^\pm$p elastic scattering and the polarization for charge-exchange scattering in the backward direction are given as predictions. (auth)

30607 REGGE-POLE MODEL WITHOUT PARITY DOUBLETS IN THE S-CHANNEL AND πN CHARGE EXCHANGE SCATTERING. Kenmoku, M. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 50: No. 5, 1579-1593(Nov 1973).

A model is proposed which has good features of the Regge-pole model and those of the dual absorptive model without requiring any parity-doublet mechanism in the s-channel. The basic assumptions of our model are the following: 1) The prominent resonance series have no parity partners at high energy. 2) The helicity-flip amplitude is described by the Regge-pole model with $\alpha_0 \simeq 0.5$. From these two assumptions the helicity-nonflip amplitude is obtained which shows peripherality, i.e., Im $F_{3+} \simeq e^{\frac{1}{2}}J_0(b_0\sqrt{-t})$, where $b_0 \simeq 1$ fermi. Comparing the amplitude with the results from the amplitude analysis of the πN charge exchange scattering at 6 GeV/c, it is found that there need some corrections which show non-peripherality. Applying the method to the πN charge exchange scattering data, fair fits are obtained. (auth)

30608 PHENOMENOLOGICAL ANALYSIS OF K-N (π-N) SCATTERING. Duality, Existence of Z_1^* and Phase Shift Solution. Minami, S. (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 2, 554-559(Aug 1973).

The general properties of $d\sigma/d\Omega$, P, R and A for K-N (π-N) scattering are studied and both the phase shift solution and the existence of exotic resonance Z_1^* are discussed on the basis of duality. (auth)

30609 AMPLITUDE ANALYSIS OF PION-NUCLEON SCATTERING BASED ON THE PERIPHERALITY. Kohsaka, Y.; Takagi, F. (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 50: No. 5, 1594-1614(Nov 1973).

An energy-independent amplitude analysis (EIAA) of pion-nucleon elastic and charge exchange scattering is performed at P_{lab} = 6 GeV/c assuming the peripherality (the Bessel-function representation) for Im F^I_{s+}, where the superscript on the amplitude F is the t-channel isospin and the subscript 2+(±) refers to the s-channel helicity non-flip (flip). Three representative sample solutions A1, A2 and A3 of the EIAA are presented and compared with previous results of amplitude analyses, the dual geometrical model (DGM) proposed by the present authors and other related models. The three solutions have many interesting features which are different from one another and illustrate how many ambiguities exist in the determination of the amplitudes. Furthermore, an energy-dependent amplitude analysis (EDAA) is performed for P_{lab} = 2.73 ~ 17.5 GeV/c in order to investigate the s- and the t-dependence of F^I_{s+}, and a P-P′ separation of Im F^I_{3+} is attempted by assuming the peripherality for the P′ term. It is found from the results of the EIAA and the EDAA that i) the DGM is consistent with the solution A1 of the EIAA if the pomeron part of F^I_{3+} has an appropriate negative real part, ii) the result of Re F^I_{3+} is very sensitive to the value of the radius of the peripheral interaction (the radius appearing in the argument of the Bessel function), iii) various conventional approximations based on the assumption that F^I_{3+} is predominantly imaginary are quantitatively invalid in some cases, and iv) the peripherality of the P′ part of Im F^I_{3+} is preserved if the pomeron part shrinks definitely as s increases. (auth)

30610 PION-NUCLEON SCATTERING AMPLITUDES AT ENERGIES BETWEEN 1.5 AND 14 GeV AND SMALL MOMENTUM TRANSFER. Hecht, H. (Univ., Karlsruhe, Ger.); Kroll, P.; Jakob, H. P. Nucl. Phys.; B71: No. 1, 1-28(1974).

From differential cross-section data of $\pi^\pm$p elastic and charge exchange scattering as well as from the polarizations of the elastic processes the πN scattering amplitudes are evaluated for energies between 1.5 and 14 GeV and momentum transfers between −0.05 and −0.4 (GeV/c)^2. The analysis starts from approximations of the amplitudes which are improved by iteration, using fixed-t dispersion relations and the experimental data. The resulting charge exchange amplitudes show a structure consistent with the dual absorptive model. No indication was found that tensor exchange is present in the case of the isospin even amplitudes. Although not used in the analysis the amplitudes give the charge exchange polarization and spin rotation parameters in agreement with measurements. (auth)

30611 PHASE-SHIFT ANALYSIS OF $K^+N \to KN$ SCATTERING IN THE I = 0 STATE UP TO 1.5 GeV/c. BGRT Collaboration. Nucl. Phys.; B71: No. 1, 138-171(1974).

Results are presented of energy-dependent and energy-independent phase-shift analyses below 1.5 GeV/c for $K^+N \to KN$, I = 0 scattering. (auth)

30612 CONDITIONS ON EXCHANGE MECHANISMS FOR POLARIZATION EFFECTS IN INCLUSIVE REACTIONS. Salin, P. (CERN, Geneva); Soffer, J. Nucl. Phys.; B71: No. 1, 125-137 (1974).

In the framework of Mueller-Regge phenomenology it is investigated under which conditions one could expect to observe polarization effects in the fragmentation region for inclusive reactions. On the basis of kinematical considerations and parity relations only, it is found that this requires exchange of states with mixed naturalities. (auth)

30613 NEW SUM RULE FOR THE PRODUCT OF SCATTERING AMPLITUDES. Seth, V. P. (Univ. of Allahabad, India); Agarwal, B. K. Lett. Nuovo Cim.; 9: No. 10, 388-390(9 Mar 1974).

A superconvergence relation for the product of the crossing-even and crossing-odd scattering amplitudes is proposed. The sum rule is tested for the process $\bar{K} + N \to K + \Xi$. (LBS)

Strong (Baryon No. ≥ 2)

30614 (COO-1195-284) COHERENT PION DISSOCIATION INTO THREE PIONS ON HEAVY NUCLEI. Kruse, U. E.; Roberts, T. J. (Illinois Univ., Urbana (USA)). Mar 1974. Contract AT(11-1)-1195. 9p. Dep. NTIS $4.00.

A partial wave decomposition was made of the final state 3π system produced in the reaction $\pi^- + A \to (\pi^-\pi^-\pi^+) + A$ at 23 GeV/c and for the elements C, Al, Cu, and Ag. For low 3π masses, the 1^+ state is dominant and its t′ distribution shows the expected combination of coherent and incoherent components. The t′ distribution of the 2^+ A_2 state also requires both coherent and incoherent components. (auth)

30615 (ORO-3992-180) ABSORPTION FORMALISM FOR MULTIPARTICLE PRODUCTION AND THE INCLUSIVE TRANSVERSE DISTRIBUTION. Chiu, C. B.; Wang, K. H. (Texas Univ., Austin (USA). Center for Particle Theory). 1974. Contract AT(40-1)-3992. 25p. (CPT-224). Dep. NTIS $4.25.

The need of absorption in simple multiperipheral-like models is further reviewed and motivated and a general formalism for multiparticle production with absorption is presented. With this formalism, the well known unitarity relation is reproduced and new expressions are derived for inclusive momentum distributions. It is demonstrated that the parameter-free predictions based on

an earlier solution to the elastic data reproduce the gross feature of the inclusive p_T-data of high energy pp collisions. (auth)

30616 (ORO-4317-35) TRITON BINDING ENERGIES WITH TWO-BODY RADIAL DISTORTION UNITARY TRANSFORMS. Technical Report 74-059. Lavine, J. P.; Stephenson, G. J. Jr. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Feb 1974. 26p. Dep. NTIS $4.50.

The triton binding energies are determined for a class of potentials that arise from radial distortion unitary transformations. These potentials are phase-shift equivalent to a two-term Yukawa potential, which represents an average of the $^3S_1$ and $^1S_0$ nucleon-nucleon potentials. An angular-momentum decomposed version of the Faddeev–Lovelace equations that were developed, in order to obtain the three-body binding energy, E_T, is solved. It is observed that E_T varies slightly with these potentials, and it is found that they yield similar deuteron wave functions, in accord with the results reported by Haftel. Some evidence is discussed on the sensitivity of nuclear matter and three-body calculations to off-shell variations of the two-body t-matrices. (auth)

30617 (RL-74-22) TRIPPLE-REGGE ANALYSIS OF pp → pX AND SOME RELATED PHENOMENA: A DETAILED STUDY. Roy, D. P.; Roberts, R. G. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Jan 1974. 52p. Dep. NTIS (U.S. Sales Only) $5.75.

A phenomenological analysis of all available data on the reaction pp → pX is carried out, using the triple-Regge formalism and the technique of finite mass sum rules. Various inconsistencies in the data are discussed, and it is pointed out how such ambiguities can be resolved. The results show that diffraction scattering is dominated by the triple Pomeron term which shows no tendency to vanish at t = 0. By parametrizing the values of the trajectories and couplings resulting from the fits to data, what seems to be the most likely description of inelastic diffractive scattering is arrived at. This description predicts that the diffractive cross section would rise by 3.3 mb between 200 and 2000 GeV/c (experimentally σ_{INEL} rises by 3.8 ± 0.8 mb). The connection between these two increases according to several models is then discussed in the context of the estimates. A final discussion deals with the implications of the analysis for the multiplicity distributions and long range effects in multiparticle production. (auth)

30618 (RL-74-34) DIPOLE POMERON ANSATZ. Phillips, R. J. N. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Feb 1974. 7p. Dep. NTIS (U.S. Sales Only) $4.00.

A simple Regge dipole formula, taken either by itself or as the driving term in a multiple-scattering series, has many of the observed features of very high energy pp elastic scattering, including geometrical scaling. This dipole approximates to a Regge pole with intercept $\alpha(0) = 1 + \epsilon$, in a limited energy range, but has quite different asymptotics. For such dipoles, the ISR energy range is asymptotic. (auth)

30619 ANALYSIS OF MULTIPLICITY DISTRIBUTIONS IN SHORT-RANGE CORRELATION MODELS. Baier, R.; Widder, F. (Univ., Graz). Nuovo Cim.; 20A: No. 2, 260-270(21 Mar 1974).

The general multiplicity distribution for models with only short-range correlations can be approximated by a Gaussian times a power series in $1/\langle n \rangle$, which corresponds to an expansion of the general distribution around its single maximum. This approximate distribution is compared with experimental prong cross sections for inelastic p-p scattering and the necessity of an additional (diffractive) mechanism is investigated. (auth)

30620 EFFECTS OF FERMI MOTION ON DEUTERIUM SCATTERING NEAR A RESONANCE. Ferreira, E. (Universidade Catolica, Rio de Janeiro); Rosa, L. P.; Thome, Z. D. Nuovo Cim.; 20A: No. 2, 277-287(21 Mar 1974).

In the framework of the impulse approximation, the effects of Fermi motion on the evaluation of differential cross sections for elastic scattering by deuterons are studied. It is shown that the influence of Fermi motion may become very strong in the region of energies where a resonance occurs in the interaction of the incident particle with the individual nucleons. The calculated effects are more pronounced in the backward directions, where a factor of two may occur between the values obtained with and without account taken of the dependence of the two-particle amplitudes on the nucleon motion. (auth)

30621 DIFFRACTION: THE BARE POMERON, AND THE MULTIFIREBALL EXPANSION. Dash, J. W. (Argonne National Lab., IL). Phys. Lett.; 49B: No. 1, 81-85(18 Mar 1974).

A specific multifireball model incorporating a bare Pomeron with intercept 0.85 and a renormalized Pomeron with intercept 0.99 is used to study diffraction in inelastic processes. It is concluded that this effect can be much larger than the easily accessible low mass diffraction cross section. In particular, it is noted that experimentally, events with maximum rapidity gap greater than 2 form half the inelastic cross section at 200 GeV/c, and that charge transfer zero predominates across the maximum gap. (auth)

30622 POLARIZED HYPERON PRODUCTION WITH A HIGH ENERGY POLARIZED PROTON BEAM. Swallow, E. C. (Univ. of Chicago). Phys. Lett.; 49B: No. 1, 91-94(18 Mar 1974).

It is suggested that the high energy polarized proton beam now available at the Argonne National Laboratory Zero Gradient Synchrotron may provide a copious source of polarized hyperons, particularly lambdas. The potential value of this beam for investigating production processes is emphasized. (auth)

30623 HIGH ENERGY SCATTERING AND HADRON STRUCTURE. Kuroda, M.; Miyazaya, H. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 2, 569-573(Aug 1973).

High energy proton-proton scattering is analyzed using the geometrical impact parameter representation. Assuming that the proton is a composite state of quarks, whose distribution within the proton is expressed by the electromagnetic form factors, the quark-quark scattering amplitude is obtained. The analyses indicate that the proton is made of almost structureless particles. (auth)

30624 COMMENTS ON MODELS FOR POLARIZATION STRUCTURE AT HIGH ENERGIES. Miyamura, O. (Osaka Univ., Toyonaka, Japan); Kawaguchi, M.; Moravcsik, M. J. Progr. Theor. Phys. (Kyoto); 50: No. 2, 545-553(Aug 1973).

A number of simple intuitive models are considered for high-energy amplitudes of particle reactions and their consequences are calculated for high-energy nucleon-nucleon interaction in terms of predictions for the various experimental observables involving polarized particles. A prescription is given for the set of experiments which can test the models. (auth)

30625 HYPERON–NUCLEON INTERACTIONS AND $\Lambda\Sigma\pi$ COUPLING CONSTANT. Iwao, S. (Kanazawa Univ., Japan); Shako, M. Progr. Theor. Phys. (Kyoto); 50: No. 2, 560-568(Aug 1973).

The charge-independence hypothesis and the time-reversal invariance are tested by making use of available information for the hyperon–nucleon interactions. The $\Lambda\Sigma\pi$ coupling constant is estimated from the real part of p-wave amplitude at low-energy $\Sigma^- p \to \Lambda n$ reaction in comparison with the corresponding partial wave amplitude due to the one-pion-exchange non-local potential. The physical implication of the result is discussed in connection with analyses of previous authors on baryon–baryon interactions. (auth)

30626 COMPETING SCALING LAWS IN DEEP INELASTIC HADRON COLLISIONS. Halzen, F.; Luthe, J. (Univ. of Wisconsin, Madison). Phys. Lett.; 48B: No. 5, 440-444(4 Mar 1974).

Using a variable equivalent to the one proposed by Bloom and Gilman in electroproduction, it is shown that high p_T NAL and ISR data are consistent with the scaling law $p_T^n Ed^3\sigma/dp^3 = F(2p_T/\sqrt{s}, \theta)$ for both n = 4(scale independence) and n = 8 (e.g. the rearrangement model). The mass scale introduced in the n = 4 model (gluon mass?) is about a factor three larger than the one required for the n = 8 case in order to achieve consistency with the present data. Potentially fruitful experimental explorations are discussed. (auth)

30627 HIGH ENERGY PROTON–PROTON TOTAL CROSS SECTION AND COSMIC-RAY DATA. II. Auger, J. P. (Faculte des Sciences, Orleans, France); Lombard, R. J. Phys. Lett.; 48B: No. 5, 445-448(4 Mar 1974).

The proton-air-nuclei absorption cross section is discussed on the basis of new cosmic-ray data. The results are compared to theoretical estimates performed by using the multiple scattering theory and by assuming two different types of asymptotic behavior for the N-N scattering amplitude parameters. (auth)

30628 RISE OF PROTON–PROTON TOTAL CROSS SECTION AND INCLUSIVE SPECTRA. Sakai, S. (Tokyo Univ.). Phys. Lett.; 48B: No. 5, 427-430(4 Mar 1974).

The origin of the rise of p-p total cross section (σ_t(pp)) is investigated by making use of the inclusive sum rule. The contribution to the rise of σ_t(pp) from the development of sharp peak near the kinematical boundary in the process p + p → p + "anything" is almost completely canceled out by the decrease of the cross section in other x-region between $s = 45$ (GeV/c)^2 and $s = 2820$ (GeV/c)^2. Then the net contribution to the rise of σ_t(pp) from the process p + p → p + "anything" is very likely to be zero. The true origin of the rise of σ_t(pp) is found to be the increase of inclusive cross sections at $x \cong 0$ between PS and ISR energies. The contribution from the process p + p → π + "anything" at $x \cong 0$ to the rise of

σ_t(pp) is estimated to be 3.2 mb, that from the process p + p → K + "anything", 0.71 mb and that from the process p + p → $\bar{p}$ "anything", 0.62 mb. It is expected that all total cross sections will rise with energy at high energy. (auth)

30629 ISOBAR AND FIREBALL MASSES IN HIGH ENERGY N–N INTERACTIONS. Sitte, K. (Univ., Freiburg, i. B.), Dardo, M. Nuovo Cim.; 20A: No. 3, 452-462(1 Apr 1974).

The multiplicity distribution resulting from fluctuations in the four-momentum transfer in N–N collisions is derived under the assumptions of a modified isobar-fireball model. It is found to depend on $n_s/\langle n_s \rangle$ only, and to be in satisfactory agreement with data at accelerator energy. The masses and LS Lorentz factors of isobars and fireballs are compared with the Chacaltaya data on H-quanta and SH-quanta. Events in which the isobar secondaries carry off the major part of the transferred energy are shown to have H-quanta characteristics. "Torpedoes" can be interpreted as extreme cases of this kind. Conversely events with dominating energy transfer to the fireball secondaries exhibit the essential features of SH-quanta. Thus the Chacaltaya results can be understood without the expedient of hypothetical new elementary states of matter. (auth)

30630 SPECTATOR ISOBAR PRODUCTION WITH A DEUTERON TARGET. Kissliger, L. S. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 48B: No. 5, 410-412(4 Mar 1974).

The reaction π + d → π + Δ + Δ_s is studied in the peripheral model in order to obtain estimates of the spectator energy and angular distributions for such experiments. The differential cross section with respect to the laboratory kinetic energy of spectator Δ's for 15 GeV incident pion is obtained by using the impulse approximation. Special features of the results are discussed. (LBS)

30631 SCALING BREAKING WITH A DIPOLE POMERON AND THE GROWTH OF PROTON–PROTON TOTAL CROSS SECTION. Antoniou, N. G.; Kouris, C. B.; Papaioannou, G. M. (Democritus Nuclear Research Center, Athens). Lett. Nuovo Cim.; 9: No. 13, 509-514(30 Mar 1974).

Using the Mueller formalism, the effect of the conjecture that the coupling of the dipole pomeron is strong only in the double Regge diagrams on the behavior of the inclusive spectrum of pions in the central region, the rising of the inelastic proton–proton cross section at the ISR energies, and the asymptotic behavior of the average multiplicity. For this purpose the Mueller expansion in the central region is used assuming that the leading singularity (pomeron) is a dipole with intercept 1. (JFP)

30632 ESTIMATE OF LEADING-PARTICLE EFFECTS IN pp COLLISIONS. Bassetto, A. (Univ. of Copenhagen); Dias de Deus, J. Lett. Nuovo Cim.; 9: No. 13, 525-531(30 Mar 1974).

The physical meaning of the leading parameter effects is explored further, and a value for the parameter constant α (interpreted as the amount of leading-particle effect) is obtained from independent theoretical considerations. The p + p case is considered. (JFP)

30633 MULTIPLE SCATTERING IN SOME EXACTLY SOLUBLE MODELS. Thakur, J. Cleveland; Case Western Reserve Univ. (1973). 109p. University Microfilms Order No. 74-2570. Thesis (Ph.D.).

Several field theoretic models were constructed to study the scattering of elementary particles by composite systems such as nuclei, with a view to clarifying certain features which cannot be adequately described by Glauber type theories. The models are significant generalizations of the Lee model and are all exactly soluble. The first two of these describe scattering by a spatially extended target consisting of a number of target particles fixed at arbitrary points. In the first case, the target particles are non-interacting, while, in the second case, they can interact via exchange of mesons. In both cases, the scattering amplitude can be found by essentially algebraic methods. It is shown further that the scattering amplitude satisfies the Watson multiple-scattering formula and are pointed out. The third and final model considers the scattering of a meson by fixed target particles which interact via exchange of the same meson. (A situation similar to this must occur in pion-deuteron scattering, where a substantial part of nucleon–nucleon force is also believed to be due to pion exchange). The solution of this model requires solving a singular integral equation of Kallen-Pauli type. One is restricted by mathematical complexity to consider only the case of zero separation between target particles. The result in this model shows the presence of terms which need not correspond to multiple scattering. (Diss. Abstr. Int., B)

Particle Invariance Principles and Symmetries

Applications (Electromagnetic and Weak)

Refer also to abstracts 30495 and 30543.

30634 SPECTRAL SUM RULES BASED ON THE WILSON EXPANSION IN THE (3, $\bar{3}$) + ($\bar{3}$, 3) MODEL OF CHIRAL SYMMETRY. Auvil, P. R. (Northwestern Univ., Evanston, IL); Deshpande, N. G. Phys. Lett.; 49B: No. 1, 73-76(18 Mar 1974).

A new set of sum rules relating symmetry breaking parameters in the pseudoscalar meson sector is derived. These results, combined with previously derived sum rules, completely determine the symmetry breaking parameters. Good agreement with K_{13} results is obtained along with predictions of $\Gamma(\eta' \to 2\gamma)$ and $\Gamma(\eta' \to 3\pi)$ which are consistent with experiment. (auth)

30635 EXPERIMENTAL CONSEQUENCES OF MASSLESS QUARKS. Heimann, R. L. (Cavendish Lab., Cambridge, Eng.). Phys. Lett.; 48B: No. 5, 453-456(4 Mar 1974).

The Bjorken scaling function for ν σ_L/σ_T in the light-cone algebra with no order $1/\nu$ corrections to scaling of νW_2. Quarks are then massless, and polarized electroproduction is suppressed by a power of ω at large ω. (auth)

Applications (Strong)

Refer also to abstract 30592.

30636 (JINR-E2-7618) NONZERO MASSES OF π, K, η, and κ MESONS AND ALGEBRAIC REALIZATION OF SU(3) × SU(3) CHIRAL SYMMETRY. Dubnickova, A. Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Algebraic realization of SU(3) × SU(3) symmetry with linearization on SU(2) × Y subgroup taking into account masses of π, K, η, and κ mesons in virtual states is investigated. This is achieved by explicit breaking of the symmetry. The chosen form of the breaking term in Lagrangian enables one to estimate the parameter c appearing in the squared mass operator. The obtained value of c(c ≈ −1.17) is very close to that predicted by Gell-Mann, Oakes, Renner. (auth)

30637 BROKEN SU(4) × SU(4(SYMMETRY AND ETA–X MIXING. Dicus, D. A. (Univ. of Texas, Austin); Mathur, V. S. Phys. Lett.; 49B: No. 1, 63-66(18 Mar 1974).

Starting with chiral SU(4) ⊗ SU(4) symmetry of strong interactions, the implications of explicit symmetry breaking terms that transform as the (4, 4*) ⊗ (4*, 4) representation are discussed. In particular, the η–X mixing problem is studied. (auth)

30638 REPRESENTATION MIXING AND THE KSFR RELATION. Wada, S. (Tokyo Univ.). Lett. Nuovo Cim.; 9: No. 10, 381-384(9 Mar 1974).

The Melosh transformation is applied to the relativistic quark formalism ($\bar{U}_{12}$ formalism) to derive the relation between the pion decay constant f_π and the γ–ρ coupling constant, $f_\pi = \eta\, m_\rho/f_\rho$. For η equal to $1/\sqrt{2}$, the relation becomes the KSFR relation and is satisfied by the experiments. (LBS)

Scattering Theory

Refer also to abstract 31099.

30639 (ITF-73-46-E) FEYNMAN AMPLITUDE AND THE MEIJER'S FUNCTION. A Unified Representation for Divergent and Convergent Graphs. Kucheryavyi, V. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 47p. Dep. NTIS (U.S. Sales Only) $5.75.

A parametric α-representation of Feynman amplitude for any spinor graph, which is expressed in terms of the Meijer's G functions, is obtained. This representation is valid both for divergent and convergent graphs. The available Chisholm-Nakanishi-Symanzik α-representation for convergent scalar graph turns out to be a special of the formula obtained. Besides that, the expression has a number of useful features. This representation automatically removes the infrared divergencies connected with zero photon mass. The expression has a form in which the scale-invariant terms are explicitly separated from the terms breaking the invariance. It is shown by considering the simplest graphs of quantum electrodynamics that this representa-

tion keeps gauge invariance and Ward's identity for renormalized amplitudes. (auth)

30640 ENERGY DEPENDENT SEPARABLE APPROXIMATION TO OPTICAL POTENTIALS. Bhatia, R. P. Amherst, MA; Univ. of Massachusetts (1973). 75p. University Microfilms Order No. 73-31,063.

Thesis (Ph. D.).

An extension of the single-pole separable approximation of a two-body t-matrix in which the effects of several poles are included is made. The simple form for the t-matrix derived from a single separable potential is retained. However, the separable potential is constructed using an energy-dependent superposition of the states corresponding to the various poles. The energy dependence is chosen so as to obtain the correct residue at each of these poles, while preserving unitarity. The formalism is applied to the case of s-wave scattering from attractive square wells and neutron scattering from ^{27}Al. The results are encouraging. (Diss. Abstr. Int., B)

30641 UNITARITY CONSTRAINTS ON THE ODD-DAUGHTER-ELIMINATING DUAL AMPLITUDE. Maharana, J.; Igi, K. (Tokyo Univ.). Lett. Nuovo Cim.; 9: No. 8, 289-293(23 Feb 1974).

It is shown that the unitarity content of dual amplitude in the narrow-resonance limit could be used to investigate the validity of the odd-daughter elimination of the dual amplitudes. The processes $\pi + \pi \to \pi + \pi$ and $\pi + \pi \to c +$ anything are considered. It is shown that this technique can be extended to determine the magnitude of the satellite Veneziano terms. (LBS)

30642 IMPACT-PARAMETER AMPLITUDES. Kupsch, J. (Univ. Trier–Kaiserlautern, Ger.); Stamatescu, I. O. Nuovo Cim.; 20A: No. 2, 317-353(21 Mar 1974)

The structure of impact-parameter functions is investigated for several versions of the impact-parameter representation defined for two-particle scattering amplitudes which satisfy Mandelstam analyticity and polynomial bounds. (auth)

30643 ROLE OF $l \neq 0$ COMPONENTS OF A LOCAL POTENTIAL IN THREE-BODY CALCULATIONS. Revai, J.; Raynal, J. (CEN de Saclay, Gif-sur-Yvette, France). Lett. Nuovo Cim.; 9: No. 12, 461-463(23 Mar 1974).

A study of the validity of the $\bar{V} = P_{l=0} V P_{l=0}$ approximation, in Faddeev-type three-body calculations using local potentials, is extended for scattering states. A method was developed for treating the three-particle scattering problem using the Schroedinger equation combined with hyperspherical expansion techniques. The elastic cross section of the scattering of one boson on the bound state of the other two from the elastic threshold (1.225 MeV) up to 50 MeV was calculated with both potentials. (JFP)

30644 PHASE-SHIFT AMBIGUITIES FOR SPINLESS AND $L_{max} \leq 4$ ELASTIC SCATTERING. Cornille, H. (Institut de Physique Nucleaire, Orsay, France); Drouffe, J. M. Nuovo Cim.; 20A: No. 3, 401-436(1 Apr 1974).

The manifold phase-shift ambiguities leading to the same elastic differential cross section are investigated in the case of amplitudes having a finite number of partial waves. For $L_{max} \leq 4$ it is shown that no more than two nontrivially independent solutions can exist simultaneously. (auth)

30645 DERIVATION OF THE MITRA THREE-BODY MODEL FROM THE AMADO THEORY. Sharma, V. K. (D. S. Coll., Aligarh, India); Kaushal, R. S. Lett. Nuovo Cim.; 9: No. 10, 400-402(9 Mar 1974).

It is shown that the integral equation in the Amado model for three-body problems can be reduced to that of Mitra's model written in terms of the scattering amplitude. It is noted that Mitras formalism can be extended to problems of more than three bodies by using the resonating-group method with nonlocal separable potential. (LBS)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

30646 SINGULAR SURFACES IN LIQUID HELIUM II. Tokuoka, T. (Kyoto Univ.). J. Phys. Soc. Jap.; 35: No. 6, 1767-1772(Dec 1973).

The theory of singular surface is applied to the liquid helium II and the sounds defined by the singular surfaces are investigated theoretically. Here Landau's two-fluid model is adopted as a macroscopic continuous model of helium II, and the singular surface is defined such that the densities, the temperatures, the velocities of superfluid and of normal fluid are continuous while their derivatives have discontinuous jumps across the surface. It is proved that a new sound called the fifth sound may exist, which is a transverse sound fixed in the normal fluid. It is also proved that the theory of singular surface yields Landau's first and second sounds and Atkins' fourth sound. (auth)

30647 MULTI-BRANCH STRUCTURE OF THE EXCITATION SPECTRA IN LIQUID HELIUM II. Kebukawa, T.; Yamasaki, S.; Sunakawa, S. (Osaka Univ., Toyonaka, Japan). Progr. Theor. Phys. (Kyoto); 49: No. 6, 1802-1820(Jun 1973).

The multi-branch structure of the excitation spectra in liquid helium II is clarified on the basis of the formulas from which the phonon-roton spectrum has been successfully derived in previous papers. The existence of the flat spectrum and the broad free-atom spectrum revealed by Cowley and Woods is confirmed theoretically. The new excitation spectrum with energy 40°K at momentum 1.13$\AA^{-1}$ which has recently been found by Woods, Svensson and Martel is derived and an excellent agreement with experiment is obtained. (auth)

30648 DYNAMICAL SPIN SUSCEPTIBILITY OF ANISOTROPIC SUPERFLUID IN ^{3}He. Maki, K. (Tohoku Univ., Sendai); Ebisawa, H. Progr. Theor. Phys. (Kyoto); 50: No. 5, 1452-1473(Nov 1973).

Making use of a model Hamiltonian which includes besides the kinetic energy and the BCS like pairing energy, the spin exchange interaction as well as the dipole interaction, we calculated the dynamical spin susceptibility in the anisotropic superfluid state in ^{3}He. The fluctuation of the spin couples strongly with the fluctuation of the order parameter and a consistent treatment of these fluctuations is essential in obtaining a correct result. In the absence of the dipole interaction, it is found that the dynamical spin susceptibility in the anisotropic superfluid state is identical to the one in the normal state in the uniform limit. In the presence of the dipole interaction, on the other hand, the dynamical susceptibility develops resonance poles, with the resonant frequency slightly shifted from the one in the normal state to the higher frequency side. In the case of the transverse susceptibility, the shift obtained is similar to that given by Leggett. The appearance of the resonance poles in the longitudinal susceptibility is also predicted. (auth)

30649 SUPERFLUID CONDENSATE IN LIQUID ^{4}He II. Visoottiviseth, K. Riverside, CA; Univ. of California (1973). 90p. University Microfilms Order No. 73-32,729.

Thesis (Ph. D.).

The microscopic theory of ^{4}He II has been studied, accounting for the Bose-Einstein condensation by the existence of "off-diagonal long-range order" (ODLRO) in the reduced density matrices. The principal result of this dissertation is establishment of a connection between the microscopically defined condensate density ρ_c and the superfluid density ρ_s, the latter defined phenomenologically in the two-fluid model of Tisza and London. Without relevant approximation and with a minimum of assumptions, it is deduced that $\rho_c = [\alpha/(1-\beta)]\rho_s$. The quantities, α and β, which are integrals involving the two-body potential interaction, may be calculated approximately at 0°K, giving $\rho_c/\rho = 0.21 \pm 0.05$ in satisfactory agreement with previous work of Penrose and Onsager, and McMillan. (Diss. Abstr. Int., B)

30650 SURFACE TENSION OF ^{4}He FROM 0.3 K TO T_λ. Eckardt, J. R. Columbus, OH; Ohio State Univ. (1973). 148p. University Microfilms Order No. 74-3153.

Thesis (Ph. D.).

The surface tension of superfluid ^{4}He has been measured as a function of temperature from 0.3K to the λ transition. The data also yield the surface entropy in that temperature range. The temperature variation of the capillary rise in a parallel plate capacitor was balanced with an electric field developed between the plates so as to keep the meniscus stationary. This procedure minimizes the effect of small imperfections and deviations from parallelism in the capacitor plates. It was possible to resolve relative changes in surface tension of one hundredth of a percent without great difficulty. The results have much less scatter than those from previous measurements. The experimental results were compared to a theoretical calculation of the surface entropy. The simplest version of the theory, as proposed by Atkins, assumes that the normal surface modes are capillary waves. For an incompressible liquid these capillary waves have the energy-momentum spectrum $\omega^2 = \alpha/\rho k^3$. A more developed version of the theory expands upon Atkins' treatment of the capillary waves (ripplons) and also includes the contribution of phonons to the surface properties. This version of the theory treats the case of capillary waves of a compressible quantum fluid. The model used to calculate the energy-momentum spectrum of the ripplons leads to a minimum which is very close, in both momentum and energy to the roton minimum in the empirical phonon spectrum. The calculations allow for temperature-dependence of the spectrum. Finally an empirical ripplon spectrum was found that would give a surface entropy contribution which when included with the phonon contribution accounts for the observed surface entropy. (Diss. Abstr. Int., B)

30651 FINE STRUCTURE IN THE THERMAL RESISTANCE OF HELIUM II. Childers, R. K. Columbus, OH; Ohio State Univ. (1973). 137p. University Microfilms Order No. 74-3135.

Thesis (Ph. D.).

A detailed investigation of the thermal resistance of He II contained in both glass and metal tubes with diameters of order 100 μ (10^{-2} cm) has revealed a well defined and reproducible fine structure heretofore not reported. Continuous high resolution measurements of the temperature difference ΔT between the ends of the tube and the heat current $\dot{Q}$ are displayed directly on an X-Y recorder. A distinct difference in features of the thermal resistance is observed between the glass and metal tubes. Results obtained for the glass tubes provide an important independent check on the Vinen theory and a new determination of the parameters of that theory. Some of the new features seen for the metal tubes are explainable using a somewhat modified version of the Vinen theory. These and other new features are compared with recent measurements by van der Heijden as well as with those of Brewer and Edwards. A newly predicted type of flow, may be responsible for some of the fine structure observed. (Diss. Abstr. Int., B)

30652 ENTROPY OF LIQUID HELIUM II FROM FOUNTAIN PRESSURE MEASUREMENTS. Broz, A. L. Notre Dame, IN; Univ. of Notre Dame (1973). 170p. University Microfilms Order No. 74-45.

Thesis (Ph. D.).

Fountain pressure measurements have been made for the temperature range 0.94K to 1.56K. A temperature difference (ΔT) was set up between the liquid inside and outside of a thermally insulated coaxial capacitor. The resulting level difference (ΔP) was measured by measuring the capacitance of this capacitor. Porous membrane filter material of pore size ranging from 0.1μ to 8μ was used as the superleak connecting the liquid inside and outside the capacitor. Level differences ΔP corresponding to ΔT ranging from 50μK to 2mK were recorded at each of the ambient temperatures. A linear relationship between the measured ΔP and ΔT was always obtained. The value of $\Delta P/\Delta T$ at each of these ambient temperatures was measured with precision of ±0.1%. The value of the entropy at each of these ambient temperatures was calculated from this data with accuracy of ±1.1%. These entropy values are compared with those obtained from other measurements and found to be in good agreement. (Diss. Abstr. Int., B)

30653 FREE SURFACE OF A ROTATING HeII FILM. Vittoratoes, E.; Cole, M. W.; Meincke, P. P. M. (Univ. of Toronto). Can. J. Phys.; 51: No. 21, 2283-2286(1 Nov 1973).

Stimulated by recent conflicting experimental results, the properties of quantized vortex lines in thin films of superfluid helium were investigated. The shape of the liquid-vapor interface in the presence of a single line is calculated. The depression of the interface ("dimple") that results is considerably smaller for the film than for the bulk liquid. The critical rotational frequency for the appearance of the first vortex line is only slightly reduced below the bulk value. (auth)

30654 RASTVORY KVANTOVYKH ZHIDKOSTEI: ^{3}He-^{4}He. (Solutions of Quantum Liquids: ^{3}He-^{4}He). Esel'son, B. N.; Grigor'ev, V. N.; Ivantsov, V. G.; Rudavskii, E. Ya.; Sanikidze, D. G.; Serbin, I. A. Moscow; Izdatel'stvo Nauka (1973). 423p.

The results of experimental and theoretical studies of solutions of two quantum liquids ^{3}He and ^{4}He are reported. Special attention is given to a description of the properties of the solution connected with its superfluidity. The structural diagram of the ^{3}He–^{4}He system and the phase transformations in this system are described in detail. The thermodynamic properties of the solution, propagation of sound oscillations, and the phenomenon of transfer are discussed. The use of the solution to obtain superlow temperatures by dissolving ^{3}He in ^{4}He is considered. (tr-auth)

30655 COMPARISON OF THE CRITICAL PROPERTIES OF THE S = ½ XY MODEL AND LIQUID HELIUM NEAR THE LAMBDA TRANSITION. Betts, D. D.; Lothian, J. R. (Univ. of Alberta, Edmonton). Can. J. Phys.; 51: No. 21, 2249-2259 (1 Nov 1973).

Experimental properties of the lambda line of liquid helium are used together with properties of the zero-field spin ½ XY model to determine, on the one hand, the point on the lambda line to which the zero-field model applies, and on the other hand, to determine the lattice spacing of the model. On the f.c.c. lattice the specific heat of the model, $C/Nk_B \sim -0.255 \ln (1-T_c/T) - 0.190$ near T_c. This result is shown to be in good agreement with recent experimental results of Ahlers on liquid helium. Other properties of the S = ½ XY model are also calculated and, where comparison can be made, agree well with experiment. (auth)

30656 QUASICRYSTAL MODEL OF LIQUID HELIUM. I. Ground State. Priezzhev, V. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Physiol. Pol.; A45: No. 3, 343-357(1974). (In Russian).

A modified ground state function for quantum crystals has been used for variational calculations of the ground state energy of liquid ^{4}He. It is shown that the ground state function for liquid ^{4}He can be represented as a symmetrical product of the one-particle wave functions multiplied by Jastrow-factor. (auth)

30657 QUASICRYSTAL MODEL OF LIQUID HELIUM. II. Collective Excitations. Priezzhev, V. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Physiol. Pol.; A45: No. 3, 359-365(1974). (In Russian).

The ground state function for liquid ^{4}He, which has been calculated in the first part (I), is used for deriving the phonon frequency depending on the wave number. A reasonably good agreement with the neutron scattering experiment is obtained without introduction adjustable parameters. (auth)

30658 PROPERTIES OF THE SURFACE AND SUPERFLUID FILM OF DILUTE ^{3}He–^{4}He MIXTURES AT LOW TEMPERATURES. Crum, D. B. Columbus, OH; Onio State Univ. (1973). 164p. University Microfilms Order No. 74-3143.

Thesis (Ph.D.).

The transport of ^{3}He adsorbed on the surface of the superfluid helium film has been measured for selected ^{3}He concentrations up to 1200 ppm and temperatures between 30 and 200 mK. When analyzed in terms of simple kinetic theory, the results give two quantities related to the coupling between bulk and surface ^{3}He states: g_0, the probability that bulk quasi particles incident on the surface are absorbed into a surface state and f_2, the mean fraction of their tangential momentum lost if scattered off the surface. At low temperatures, both f_2 and g_0 become very small, corresponding to almost complete specular reflection. These measurements were made using a small bucket with stainless steel walls contained in a larger outer chamber. After the level in the large chamber was changed, the transfer of helium (either through the vapor or superfluid film) was monitored with a capacitor semi-immersed in each chamber. The values of f_2 and g_0 determined from these transfer rates appear not to be a function of the ^{3}He chemical potential, but the data has too much scatter to rule out a dependence on the surface density. Within experimental error, both f_2 and g_0 are merely proportional to the temperature. The superfluid film flow rate and the film profile (thickness as a function of height) were also measured for similar concentrations but over a wider range of temperature. The film profile, apart from a small hysteresis effect, agrees with the simple Frenkel–Schiff theory using the van der Waals potential calculated from the Lifshitz equation. The film flow rates are observed to decrease in the region where substantial amounts of ^{3}He are known to be adsorbed on the surface. For the highest concentration used (0.44%), the flow rate below 100 mK increases rapidly with decreasing temperature; this is apparently connected with the beginning of Fermi degeneracy in the dissolved ^{3}He. A series of surface tension measurements were also made for concentrations of 0.2, 306, 604 and 1200 ppM at temperatures less than 700 mK. These results are similar to the results of Guo et al., but yield different values of the surface binding energy, and indicate that there is a weak repulsive interaction between the surface quasiparticles. (Diss. Abstr. Int., B)

30659 RAYLEIGH DISK IN DC HELIUM II COUNTERFLOW. Lynch, R. F. Irvine, CA; Univ. of California (1973). 61p. University Microfilms Order No. 73-31,448.

Thesis (Ph.D.).

The torque on a Rayleigh disk in dc ("direct current") helium II counterflow produced by a heater has been measured over the temperature range 0.969 K to T_λ, mostly in the supercritical regime (superfluid velocities greater than the critical velocity). It is found that the temperature dependence of the torque is in good agreement with the two-fluid model of helium II and an extension of the classical Koenig expression for a Rayleigh disk in potential flow. However, the magnitude of the torque is smaller than the theory by approximately 50%. Experimental observations of higher torque values approaching theory below a transition in the torque vs. heater power squared curves at low temperatures (~1.2 K), attributed to a transition from sub-critical to super-critical flow in the channel and independent observations of Hall indicate that the torque deficit may be due to super-critical flow in the channel rather than anomalous behavior of the Rayleigh disk. In view of the evidence that the normal fluid flow about a Rayleigh disk is Helmholtz rather than potential, the predictions of Trela's model of helium II flow, as extended to counterflow, was examined. The fit to the experimental data was found to be very poor. It is suggested that these findings, in direct contradiction to a number of other investigations, notably the "λ-point anomaly" found by Pellam, may be due to some difference in the flow hydrodynamics in counterflow (zero net mass flow) as opposed to net mass flow. (Diss. Abstr. Int., B)

Superconductivity

30660 (AD-770085) ULTRASONIC STUDIES OF ELECTRONIC AND MAGNETIC PROPERTIES OF SOLIDS. Final Technical Report. Thomas, R. L. (Wayne State Univ., Detroit, Mich. (USA). Dept. of Physics). Oct 1973. 17p. (AFOSR-TR-73-1983). NTIS $3.00.

Experimental and theoretical studies of the electromagnetic sound generation have been carried out in bismuth and gallium, resulting in a basic understanding of this effect. High field studies have contributed useful information on their electronic properties. Further studies have been made of the possible antiferromagnetic state of potassium. High resolution sound velocity instrumentation has been applied to studies of the magnetic properties of glasses, alloys and crystals. Preliminary studies have been made of interactions of phonons with electrons in superconducting films. (auth)

30661 (CALT-822-59) SUPERCONDUCTIVITY IN METAL-SEMICONDUCTOR EUTECTIC ALLOYS. AEC Research and Development Report No. 51. Tsuei, C. C.; Johnson, W. L. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Mar 1974. Contract AT(04-3)-822. 40p. Dep. NTIS $5.00.

In an eutectic alloy obtained by melting the constituents, alternating domains of metal and semiconductor can exist in a well defined microscopic array. The possibility of superconductivity arising from an interface interaction between the metal and semiconductor has been investigated. Superconductivity has been observed as a bulk property of some eutectic alloys (e.g., Al–Si and Al–Ge). Transition temperatures (T_c) well in excess of those for the pure metal were found. The effect of rapid-cooling the alloys from the liquid state on the microstructure, and on the superconducting properties has been studied. It was found that a decrease in the characteristic domain sizes of the metal and semiconductor was accompanied by an increase of the superconducting transition temperature of the alloy. The results suggest that the enhancement of T_c depends on the Fermi energy of the metal. In metal–metal eutectic systems with comparable microstructure, no increase of T_c was observed. Several explanations of the experimental findings are considered. The exiton mechanism discussed by Ginzburg and by Allender, Bray, and Bardeen, provides a plausible account for the enhancements of the metal T_c's. (auth)

30662 (KFK-EXT-3/72-11) REPORT ON HIGH-FREQUENCY SUPERCONDUCTIVITY. Halbritter, J. (comp.). (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Oct 1972. 115p. (In German). Dep. NTIS (U. S. Sales Only) $7.75.

Five papers on superconductors in microwave fields are presented. Separate abstracts are prepared for each paper. (MHR)

For abstracts of individual papers see: 30233, 30663, and 30675–30677.

30663 (KFK-EXT-3/72-11, pp E.1-21) SUPERCONDUCTIVITY IN MICROWAVE FIELDS. Hasse, J. (Univ., Karlsruhe, Ger.). Oct 1972. (In German).

From application of superconductivity in electrical engineering and high energy physics conference; Titisee, Ger. (9 Oct 1972).

The data on superconductors that can be obtained from high frequency measurements are illustrated and discussed. The factors affecting the surface resistance are calculated. A comparison is made of the transition temperature of some elements in the amorphous and crystalline states. Surface resistance measurements made on a Pb–Bi alloy are reported and discussed. (JSR)

30664 (KFK-EXT-3-73-7) ELECTRON SINGLE PARTICLE STATES IN THE FLUXLINE LATTICE IN PURE TYPE-II-SUPERCONDUCTORS. Ries, G. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Jan 1974. 47p. (In German). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis. Submitted to Karlsruhe Univ. (West Germany). Faculty fuer Physik.

In a pure type-II-superconductor containing a fluxline lattice energy eigenvalues and wave functions of electron single particle states are evaluated solving the Bogolyubov equations. Two classes of states are found, bound states which are localized around the fluxline axes and nonlocalized continuum states. The bound states have energies in the range of the BCS gap and are responsible for the gapless behavior of a type-II-superconductor in a magnetic field. For fluxline lattice parameters $d \gtrsim 6\xi$ (ξ: coherence length) they are identical with the bound states in an isolated fluxline as evaluated by other authors. The continuum states have merely a BCS-like spectrum. Additionally in the periodic pair potential forbidden energy zones occur, the spectrum has a bandstructure. It is shown that the existence of gaps leads to a negative contribution to the free energy of the superconductor which depends upon the fluxline lattice parameter. This can be interpreted as an attractive interaction between fluxlines and explains the discontinuity in the magnetization at H_{c1} as observed in pure materials. An expression for the equilibrium fluxline lattice parameter d_0 is derived and compared with experiments. (auth)

30665 NATURAL FLUCTUATIONS OF THE JOSEPHSON CURRENT. Landa, P. S.; Tarankova, N. D. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 611-614(1973). (In Russian).

The fluctuations of the amplitudes of the natural Josephson's current connected with the discrete charge and dissipation arising during tunneling of Cooper pairs through superconductor–dielectric–superconductor transitions were examined. The fluctuations examined do not disappear during the approach to zero of the resistance of the external circuit. (JSR)

30666 LATTICE INSTABILITIES IN HfV_2 AND ZrV_2 SUPERCONDUCTORS. Takashima, T.; Hayashi, H. (Kobe Steel, Ltd., Japan). Jap. J. Appl. Phys.; 12: No. 10, 1659-1660(Oct 1973).

30667 SUPERCONDUCTING TRANSITION BEHAVIOR OF TERNARY ALLOYS OF TITANIUM. Cotton, W. L.; Taggart, R.; Polonis, D. H. (Univ. of Washington, Seattle). Scr. Met.; 8: No. 4, 329-336(Apr 1974).

The feasibility of increasing T_c of Ti–Nb alloys by adding a ternary element (Mo or Al) to $Ti_y(Nb_xX_{1-x})_{1-y}$ was investigated. T_c vs electron: atom ratio plots show that Mo depresses T_c and that alloys containing 5 to 10 at. % Al show sharp transitions, and 20 to 25 at. % Al show broad and double transitions. Results show that the electron : atom ratio is not a sufficient criterion for predicting T_c in multicomponent alloys. (DLC)

30668 ELECTRON TUNNELING MEASUREMENTS OF THE SUPERCONDUCTING ENERGY GAP OF GALLIUM. Polick, J. J. Columbus, OH; Ohio State Univ. (1973). 270p. University Microfilms Order No. 74-3291.

Thesis (Ph. D.).

A method for fabricating tunneling barriers on gallium single crystals has been developed, and preliminary measurements of the superconducting energy gap have been carried out between 0.35 and 1.1K. The C-axis has been studied most extensively, and $E_g(0,\vec{C}) = (0.30 \pm 0.01)$MeV. The data for the A and B directions were collected during the early stages of the experiment, and exhibits appreciable scatter: $E_g(0,\vec{A}) \sim E_g(0,\vec{B}) = (0.32^{+0.01}_{-0.04})$ MeV. Several off-axis samples have been measured, but no multiple gaps have been found thus far. Subharmonic and/or multiparticle currents have been observed within the gap in Ga/I/Pb and Ga/I/Sn junctions. E_g values obtained from this fine structure are in reasonable agreement with the single-particle tunneling data. (Diss. Abstr. Int., B)

30669 WEAKLY-LINKED BULK SUPERCONDUCTORS. Saxena, A. M. Jamaica, NY; St. John's Univ. (1973). 127p. University Microfilms Order No. 73-29,975.

Thesis (Ph. D.).

An investigation of some of the properties of aluminum particles of microscopic size prepared by evaporation technique has been made at low temperatures, near and below superconducting transition temperature. The susceptibility measurements on aluminum particles having dimensions much smaller than the G-L coherence length were made in uncompacted state using a tunnel diode oscillator. The influence of electromagnetic radiation on the compressed aluminum particles was investigated in detail. When the particles are pressed together to a suitable extent to form a macroscopic sample with particles weakly linked with one another, an incident radiation of frequency 0.5Mhz-4GHz induces a stable zero-bias dc voltage across the sample. In order to strengthen the given explanation of the induced dc voltage further investigations of dI/dV curves, magnetic field dependence of the dc voltage, and current dependence of the resistive transition were also undertaken. (Diss. Abstr. Int., B)

30670 BULK AND SURFACE CRITICAL FIELDS OF TANTALUM AND TANTALUM NIOBIUM ALLOY SINGLE CRYSTALS. Weber, J. L. Worchester, MA; Clark Univ. (1973). 203p. University Microfilms Order No. 74-1739.

Thesis (Ph. D.).

The relation between surface and bulk superconductivity was investigated by comparison of the magnetic critical fields of these states in single crystal samples of pure tantalum and Ta 2%Nb at temperatures from 4.4K to 1.6K and Ta 4%Nb between 4.4K and 3.6K. The bulk critical fields were determined from magnetization data taken by flux integration in a slowly varied applied field. The surface critical fields were determined from ac susceptibility measurements at 1070 Hz, as the applied dc field was varied. It was found that the behavior of the surface sheath differs considerably between the type-II and type-I superconductors. The theory of P. K. Sarma fit our type-II data well with a value of one for his scattering parameter, p. This value, corresponding to diffuse scattering, required more scattering near the surface than we expected from our highly polished surfaces. This could be explained by a change in the surface sheath geometry. The surface critical field was considerably depressed with the ratio H_{c3}/H_{c2} approaching one near T_c for the type II data. The ratio H_{c3}/H_{c2} for the sample of Ta 4%Nb could be well fitted to the Hu and Korenman theory with the incorporation of the Indovina, Matzeu, Onori and Tabet (IMOT) results for a positive value of ξ/b, .02. For the sample of Ta 2%Nb at the temperatures where it was type 2, ξ/b was again positive. At the higher temperatures where the sample was type-I, this parameter appeared to change to a small negative value (–.002). The Ginzburg-Landau parameter, K, was determined for the type-I data from the ratio H_{c3}/H_c by use of the Saint-James deGennes (SJdG) and the IMOT theories. These K values were extrapolated to a value of K_0 equal to 0.36 by use of the Gor'kov Goodman relation. This value was in good agreement with the recent results of Auer for purely bulk measurements in Ta and our own type II magnetization data. The agreement between the type-I data and the theories based on a simply connected sheath suggest that the geometries of the sheath are different for type-I and type-II superconductivity. A model is presented for the change in geometry that explains both the different behavior of the sheath in the two cases, and some features of the magnetization type-II samples that have a surface sheath. (Diss. Abstr. Int., B)

30671 INFLUENCE OF HARDENING AT DIFFERENT STAGES ON THE CREEP STRAIN JUMP AT THE TRANSITION TO SUPERCONDUCTIVITY. Soldatov, V. P.; Startsev, V. I.; Vainblat, T. I. (Physical-Technical Inst. of Low Temperatures, Kharkov). Phys. Status Solidi (a); 22: No. 1, 109-115(16 Mar 1974).

The influence is considered of the deformational hardening of metals at its different stages on the creep strain jump Δe_{ss} during the n–s transition. The curves representing the strain dependence of the jump Δe_{ss} are shown to have a phase nature. Their different phases correlate with the stages of the hardening curves. This relation is determined by a strong dependence of the jump magnitude Δe_{ss} on hardening coefficient of the metal and the activation volume. The complex behavior of the Δe_{ss} (e) dependence observed at different stages of the hardening curve can be explained by a nonmonotonic variation of the hardening coefficient along the $\tau-\xi$ curve. The experimental results on Pb undoped and doped with Sb, Cd, or Sn are in good qualitative agreement with the theory of enhanced plasticity at the n–s transition assuming thermal-activated unpinning. (auth)

30672 EXPERIMENTAL STUDY OF SELF-RESONANT MODES IN JOSEPHSON JUNCTIONS. Gou, Y. S. Buffalo; State Univ. of New York (1973). 111p. University Microfilms Order No. 74-4402.

Thesis (Ph. D.).

Self-resonant effects were studied both in a magnetic field and in zero field. The resonant modes lead to current steps in the

current-voltage (I-V) characteristics of junctions. Temperature and magnetic field dependence of these current steps were measured. The results are compared with conventional theory, as well as with a recent theory involving propagation of vortices in the junctions. In non-zero external magnetic field, current singularities corresponding to half-integral Fiske modes were found in addition to the conventional integral structure. It is supposed that these new induced steps involve harmonic generation, somewhat as predicted by Werthamer and Shapiro [Phys. Rev., 164, 523(1967)]. The temperature dependence of all of these singularities was studied and it was found that the current step height initially increases as the temperature is lowered, reaching a maximum value of 0.37 of the zero-voltage supercurrent, and then decreases again at lower temperature. It is shown that this is consistent with theory. This behavior is a consequence of the fact that tunnel current oscillation cannot lead to the emission of real photons in a system without energy dissipation and the energy dissipation becomes very small at low temperature. The damping, measured by Q, associated with the presence of quasiparticles was also investigated. In zero external magnetic field, a behavior like that reported by Chen et al. [Physica, 55, 413(1971)] was found for junctions which are somewhat wider than their Josephson penetration depth (λ_J). But a much smaller step beyond the so-called cut-off voltage was found also. For narrower junctions, different results were found. Much smaller singularities were seen located at voltages corresponding to the Fiske modes. They continue to grow as the temperature is lowered to 1.1 K, and they do not have the cut-off voltage of the wide junction singularities. (Diss. Abstr. Int., B)

30673 APPLICATIONS OF SPECIFIC-HEAT DATA TO THE THEORIES OF SUPERCONDUCTIVITY AND ITINERANT FERROMAGNETISM. Jones, R. W. Notre Dame, IN; Univ. of Notre Dame (1973). 107p. University Microfilms Order No. 74-56. Thesis (Ph.D.).

The specific heat of a metal carries information about low energy excitations in the crystal lattice (phonons) and low energy electronic excitations. A method has been developed to analyze specific heat data to yield parameters important in theories of superconductivity and itinerant ferromagnetism. These parameters are λ, the electron–phonon enhancement factor (the electron–phonon interaction is the pairing interaction responsible for superconductivity) and $N(E_F)$, the electronic density of states at the Fermi level. The analysis hinges on the ability to calculate the lattice portion of the specific heat at high temperatures. The success of such calculations, based on simple assumptions concerning the lattice, is demonstrated by comparison with lattice specific heats obtained from experimentally determined phonon dispersion curves. If λ and $N(E_F)$ are to be determined, the specific-heat data used in the analysis must be of very high accuracy. Therefore, a new differential calorimetry technique was developed by which specific heats can be obtained to an accuracy of ±0.75% over the temperature range 1.6 to 430 K. A twin sample configuration is employed, and a weak link is placed between the samples. The data analysis has been applied to many materials, both ferromagnets and non-ferromagnets. Among the non-ferromagnets, scandium, yttrium, platinum, palladium, copper, vanadium, niobium, tantalum, and V_3Ga have been investigated. There is generally good agreement between the λ and $N(E_F)$ values found from specific-heat data by the methods described herein, and those values calculated from band structures and deduced from superconducting transition temperatures. The ferromagnets nickel and $Ni_3Al_xGa_{1-x}$ alloys have been investigated in an attempt to shed light on the nature of magnetic order in these materials. In each case, there are indications of spin fluctuations above T_c. Also, analysis of the electronic entropies of these materials leads to the conclusion that the band model used to describe ferromagnetism must admit the possibility of ferromagnetic fluctuations existing at temperatures considerable above T_c. (Diss. Abstr. Int., B)

Equipment and Devices

Refer also to abstracts 30232 and 30233.

30674 (COO-3151-35) TUNABLE JOSEPHSON JUNCTION FAR INFRARED SOURCE. Report No. 2151. Eisley, R. K.; Sievers, A. J. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Jan. 1974. Contract AT(11-1)-3151. 7p. Dep. NTIS $4.00.

Radiation emitted by Nb–Nb point contact Josephson junctions at frequencies up to 30 cm^{-1} was studied. Spectroscopic measurements on solids have been made using this source. (auth)

30675 (KFK-EXT-3/72-11, pp F.1-11) EFFECTS IN REAL HIGH FREQUENCY CAVITIES. Halbritter, J. (Univ., Karlsruhe, Ger.). Oct 1972. (In German).

From application of superconductivity in electrical engineering and high energy physics conference; Titisee, Ger. (9 Oct 1972).

The use of superconducting high frequency resonators is limited by the attainable losses and field strengths which are described by the high frequency residual resistance R_{res} and the critical high frequency field strength. By improvement of the surface preparation for massive Nb $R_{res} \approx 2 \times 10^{-9}$ can be attained between 0.1 and 10 GHz. A microscopic explanation for this residual loss is lacking; but losses in the metal and the dielectric oxide coating can be excluded, that is, the losses are localized in the boundary between the metal and oxide which consists of the surface scattering of the conducting electrons. The inelastic part of this scattering dissipate the HF energy and is the origin for R_{res}. The field strengths attainable are generally limited by the magnetic-thermal breakdown starting with a nucleus. Local heating by electron bombardment, roughnesses, and precipitations (NbC, NbO, etc.) can serve as nuclei. No nucleus was identified experimentally. With outgassing or electropolishing the high frequency field strength attainable is ≥1000 G. (tr-auth)

30676 (KFK-EXT-3/72-11, pp G.1-34) APPLICATION OF HIGH FREQUENCY CAVITIES. Hahn, H. (Brookhaven National Lab., Upton, NY). Oct 1972. (In German).

From application of superconductivity in electrical engineering and high energy physics conference; Titisee, Ger. (9 Oct 1972).

A review is given of the properties of superconducting resonators and their possible applications. Although the development of the superconducting cavities was stimulated by their use in high energy physics, the multiplicity of the present and future uses in other areas of science and technology is stressed. It was shown that the introduction of high frequency superconductors can result in a price reduction for instruments and a qualitative improvement. After a brief review of the properties of superconducting resonators the usual fabrication methods, especially for Nb cavities, are described. The advantages of superconducting resonators are illustrated on the basis of some typical examples of their use in science, communication techniques, and measurement techniques. 199 references. (tr-auth)

30677 (KFK-EXT-3/72-11, pp H.1-30) SUPERCONDUCTING HIGH FREQUENCY DEVICES AND SYSTEMS. Passow, C. (Kernforschungszentrum, Karlsruhe, Ger.). Oct 1972. (In German).

From application of superconductivity in electrical engineering and high energy physics conference; Titisee, Ger. (9 Oct 1972).

The usable physical effects occurring in superconducting high frequency devices and systems include resistance changes, signal attenuation, power transmission damping, smallest detectable signal, modification by magnetic fields, and power saving because of the reduction of surface resistance. Each of these is discussed. The characteristics of the two frequency ranges in which superconducting high frequency devices offer advantages over normal conducting systems are described. The electrical behavior of strip conductors and the materials used for their preparation are discussed. Experimental studies of constituents such as resonators, filters, tuning devices, amplifiers, and mixers are reviewed. 70 references. (JSR)

30678 (LBL-2222) SUPERCONDUCTING TUNNEL JUNCTION BOLOMETERS. Clarke, J.; Hoffer, G. I.; Richards, P. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 9p. (CONF-730990-1). Dep. NTIS $3.00.

From international conference on detection and emission of electromagnetic radiation with Josephson Junctions; Perros Guirec, France (3 Sep 1973).

Two new types of superconducting infrared bolometers are described. In one, the temperature dependent Josephson current in an SNS junction is measured with a SQUID galvanometer. In the other, the temperature-dependent quasiparticle tunneling current in an SIN junction is measured with a conventional fet amplifier. Either type of junction is deposited on a low heat capacity sapphire substrate covered on the reverse side with a thin Bi film to absorb infrared radiation. The best performance achieved thus far is for the SNS bolometer which has an electrical NEP $\approx 5 \times 10^{-15}$ $W/\sqrt{Hz}$ and $D^* \approx 10^{14}$ cm W^{-1} $Hz^{\frac{1}{2}}$. Some improvement in these values is anticipated. (auth)

30679 RESPONSE OF A TOROIDAL RESISTIVE SQUID TO MODULATION BY MAGNETIC FLUX. Park, J. G.; Farrell, D. E.; Kendall, J. P. (Imperial Coll. of Science and Tech., London). J. Phys., F (London); 3: No. 12, 2169-2173(Dec 1973).

It is shown that an rf driven resistive SQUID (superconducting quantum interferometer) has a response to flux modulation independent of frequency, even though it be made entirely from normal

metal—apart from a small niobium screw and two patches of soft solder making contact with the screw. Moreover, the response is independent of the presence or absence of a superconducting screen and is the same as that of a SQUID of the same dimensions incorporating no resistive material. (auth)

30680 SUPERCONDUCTIVE CAVITY. Kojima, Y. (Tohoku Univ., Sendai); Konno, O.; Mitunobu, S.; Momose, T.; Otuka, T. Kakuriken Kenkyu Hokoku; 5: No. 2, 165-170(Dec 1972). (In Japanese).

The test results on a superconductive cavity by various surface treatments are reported, in order to accumulate basic data necessary to design a high Q superconductive linear accelerator. The cavity is made of Nb bulk. Its inner diameter is 40 mmϕ and longitudinal length is 42.37 mm. Resonance mode is TE_{011}. Resonance frequency is from 9794 MHz to 9742 MHz, and this variance corresponds to the variation of cavity dimensions due to the surface treatment. Degassing inside the cavity takes about 3 hours at 100°C. The temperature characteristics of Q-value was measured 1.8°K. This measurement was not performed by slow sweep method, but fast sweep method was employed. To get rid of Q-value variation because of surface current inside the cavity, the cavity surface was treated by three types of the surface treatment such as etching, electropolishing and annealing. The Q-value did not increase by the treatment etching, but this phenomenon seems to occur because surface cleaning was insufficient. The electropolishing increased the Q-value, for polishing thickness might be taken relatively large. The annealing decreased the Q-value. The annealing under the vacuum of 10^{-5} to 10^{-6} Torr might have possibility to deteriorate surface condition, so higher degree of the vacuum may have to be employed. After all, in order to gain the high Q superconductive cavity, the degree of vacuum must be higher than 10^{-6} Torr, and gas contamination on the inner wall of the cavity must be restrained. (JA)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 29969, 31044, 31078, 31375, and 31389.

30681 (DP-1346) STANDARD THERMAL ENERGY GROUP STRUCTURE FOR GENERATION OF THERMAL GROUP CONSTANTS FROM ENDF/B DATA. Finch, D. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Mar 1974. Contract AT(07-2)-1. 32p. Dep. NTIS $4.00.

The final specifications of a standard energy group structure for the generation of thermal group constants from ENDF/B data are presented. The report represents the work of a committee appointed by the Codes and Formats Subcommittee of the Cross Section Evaluation Working Group and is a parallel effort to work being done in the epithermal energy range. The thermal energy group structure specified in this report was accepted November 10, 1972, by the Cross Section Evaluation Working Group as the standard for generation of thermal group constants from ENDF/B data. The standard thermal group structure specified in this report is consistent with past design experience and thermal spectrum codes, and incorporates specific features for effects known to be important in nuclear design applications in the thermal energy range. Specific recommendations are made as to methods to be used for generation of thermal group constants. (auth)

30682 (LA-5473-MS) MULTI: A FORTRAN CODE FOR LEAST-SQUARES SHAPE FITTING OF NEUTRON CROSS-SECTION DATA USING THE REICH–MOORE MULTILEVEL FORMALISM. Auchampaugh, G. F. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 202p. Dep. NTIS $7.60.

The FORTRAN code MULTI shape fits a multilevel R-matrix formula to experimental neutron cross-section data by the least-squares technique. The program utilizes the multilevel formalism developed by Reich and Moore for neutron reactions involving 0, 1, or 2 fission channels per spin state. Each spin state may be chosen to represent s-, p-, d-, f-, or g-wave neutron reactions. The cross sections can be Doppler-broadened and resolution-broadened by a Gaussian function, an exponential function, or a convolution of a Gaussian and an exponential function. The program can simultaneously fit all four neutron cross sections, can handle a maximum of 1600 data points and 100 resonances, and search on at most 150 parameters. Nine sample problems and a FORTRAN listing are given in the Appendices. (auth)

30683 (PTB-FMRB-51) DIFFRACTION OF SLOW NEUTRONS ON SEMIPLANES. Friedrich, H.; Heintz, W. (Physikalisch-Technische Bundesanstalt, Braunschweig (F.R. Germany). Forschungs- und Messreaktor). Dec 1973. 44p. (In German). Dep. NTIS (U.S. Sales Only) $5.25.

Discrepancies between theory and experiment in neutron diffraction have been reported by Landkammer. Therefore, diffraction patterns of simple obstacles like absorbing straight edges or phase-shifting half-planes were observed in the coherent beam of neutrons leaving the neutron conductor tube of the FMRB. The diffraction patterns predicted by Huygens principle were calculated with the neutron spectrum taken into account. The measured first maximum in the diffraction figure of an absorbing straight edge is lower than that according to theory. The minimum produced by phase-shifting transparent half-planes seems to be independent of the phase difference, contrary to the calculations. It is shown that the roughness at the edges of the probes does not influence the diffraction patterns to the degree shown by the experiments. By use of different probe materials no influence by small-angle scattering could be observed. (18 figures, 1 table) (auth)

30684 (TID-26460(Supp.)) CINDA 73: AN INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. (International Atomic Energy Agency, Vienna (Australia)). Dec 1973. 240p. IAEA $31.00.

CINDA, the Computer Index of Neutron Data, contains bibliographical references to measurements, calculations, and evaluations of neutron cross sections and other microscopic neutron data. The present volume is a supplement to CINDA 73; both issues together contain the full CINDA file as of 1 October 1973. (RWR)

30685 (UCID-16372) CALCULATIONAL MODELS FOR LLL PULSED SPHERES. CSEWG Shielding Benchmark Collection No. SDT 10. Plechaty, E. F.; Howerton, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1973. Contract W-7405-eng-48. 48p. Dep. NTIS $5.50.

Calculational models for LLL pulsed spheres are presented, together with a discussion of the effects of simplifications. Data relevant to detector response functions, geometric configurations, and other information required in order to calculate time spectra of detached neutrons are included. (2 figures, 3 tables) (auth)

30686 VALIDITY OF THE CONVENTIONAL λ-B^2 POLYNOMIAL FOR DESCRIBING NEUTRON DECAY IN GRAPHITE. Hanna, N. N. (Atomic Energy Establishment, Cairo). Atomkernenergie; 22: No. 4, 257-261(1974).

The reported neutron diffusion parameters in graphite are inconsistent. Apart from statistical and experimental errors, the discrepancy is attributed to the way in which analysis is made. In this work the pulsed decay data measured by the various groups in graphite are carefully analyzed. The experimental and statistical uncertainties associated with the deduced parameters are computed. Goodness-of-fit criteria are used to examine the role of the B^6 term in the conventional decay polynomial. The results indicate that for $B^2 \leq 8 \times 10^{-3}$ cm^{-2} the quadratic polynomial approximately describes neutron decay in graphite. For the entire buckling range, the polynomial expression is inadequate and a new functional form has to be found. This is in agreement with that recently suggested by Rzeszot and Warda (1972), who introduced a new exponential functional form for the λ-B^2 relation. (2 tables) (auth)

30687 COMMENTS ON HALF-SPACE PROBLEMS WITH LINEAR ANISOTROPY. Thielheim, K. O.; Claussen, K. (Univ., Kiel). Kernenergie; 16: No. 10, 321-328(Oct 1973).

Milne's and albedo problem with linear anisotropy of scattering in homogeneous media is reviewed. Classification and dependence on parameters, c, of particle reproduction and b_1, of anisotropy of scattering are discussed for discrete eigenvalues. The X function and the auxiliary function $\bar{\nu}$ are presented numerically with a view toward applications. The extrapolated endpoint, z_0, the albedo, and the boundary value, which may be used as a boundary condition in asymptotic diffusion theory, are given as a function of c and b_1. (12 figures) (auth)

30688 EFFECT OF DEPTH FACTORS ON NEUTRON MODERATION LENGTH IN AQUIFEROUS COLLECTORS. Kozachok, I. A.; Riznik, Ya. M. O. (Inst. of Geophysics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 12, 1085-1089(Dec 1973). (In Ukrainian).

Neutron-moderating properties of aquiferous collectors are studied as dependent on the depth factors (rock pressure, temperature, stratal water mineralization, mineralogical density of the rock skeleton). The analysis of the data obtained showed that for the porosity interval of water saturated collectors (3 to 20%) which is most probable at great depths (to 15 km) the relative value of the variation in their neutron moderation characteristics due to the depth factors will be negligible. (auth)

30689 ANALYSIS OF DIEAWAY EXPERIMENTS IN A URANIUM-238 SPHERE. Gotoh, Y. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 10, 619-625(Oct 1973).

To analyze dieaway experiments in a highly subcritical fast system, a method is proposed that utilizes the image method to seek the solution of the time-dependent diffusion equation relevant to the early part of the time scale. Inverse Fourier and Laplace transformations are performed numerically to obtain the solution. The method was applied to the analysis of dieaway experiments on a depleted uranium spherical system. The YOM 20-group constant set and the JAERI-FAST 20-group constant set, collapsed from the original 70-energy-group set, were used in the analysis. The results of calculation agree well with the plots obtained by experiment except for the very early part of the time scale, where the uncollided neutrons from the source predominate. (auth)

30690 REPORT OF ACTIVITIES OF THE JAPANESE NUCLEAR DATA COMMITTEE, 1971–1972. Nippon Genshiryoku Gakkaishi; 15: No. 12, 832-842(Dec 1973). (In Japanese).

A progress report of the Japanese Nuclear Data Committee for the years from 1971 to 1972 is presented. The following items are generally reviewed: (1) international cooperation in the exchange of nuclear data and relevant information through IAEA and NEA, and (2) activities in the framework of the Japanese Nuclear Data Committee as well as the works performed in the

subcommittees of nuclear data and reactor constants. Those subjects such as (i) NESTOR, (ii) Fission Product Cross Section for Fast Reactor, (iii) Evaluation of ^{235}U Cross Section, (iv) Compilation of the Thermal Neutron Scattering and (v) Fission Product Reactor Constant for Thermal Reactor are topically reported. A list of reports and technical documents published in this period is also included. (auth)

30691 FAST NEUTRON DECAY MEASUREMENTS ON LEAD AND IRON BY THE USE OF CALIFORNIUM-252 AS A RANDOMLY PULSED SOURCE. Takeda, E.; Aizawa, O.; Fukano, Y. (Tokyo Inst. of Tech.). Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 116, 1-10(Mar 1973).

In this experiment, measurement of neutron decay curves was made on lead and iron systems, with a californium-252 source and by time-of-flight technique. Time origin was marked by the gamma-ray emitted simultaneously with the fission of the ^{252}Cf source. A plastic scintillator was used for neutron detection, and the gamma-ray was detected with a liquid scintillator. Detector efficiency was calibrated prior to the measurement of the neutron decay curves for lead and iron systems. The obtained decay curves were compared with calculated values. By the present experiment, the decay curves were able to be measured with high accuracy in the range above 1 MeV. They were in good agreement with the calculated values; in a lower energy range, this method may be impracticable in case of a weak source. In case of using a strong source, this method also becomes difficult because of high background. With respect to the group constant values for lead and iron, it was found that many group constant sets were satisfactory except (ABBN)c set, at least in the energy range of 1 ~ 10 MeV. In order to get information for the energy range less than 1 MeV, it seems better to measure the decay curves by a conventional pulsed neutron experiment using a strong source. (JA)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 30717, 30730, 30833, 30863, and 31044.

30692 (TLU-10-73) NONCOPLANAR PROTON CORRELATIONS FROM THE d(p,2p)n REACTION AT 10.0 MeV. Sundqvist, B.; Johansson, A.; Goenczi, L.; Koersner, I. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Apr 1973. 26p. Dep. NTIS (U. S. Sales Only) $4.50.

Noncoplanar correlation spectra for the p + d breakup reaction have been measured at T_p = 10.0 MeV for 10 pairs of angles in a kinematically complete experiment. The kinematic conditions were chosen to enhance the "quasifree" reaction mechanism. The data have been parameterized with a cutoff radius by means of the MSIA (modified simple impulse approximation) model. The model was found to describe data rather well. For the largest angles (80° and 90°) between the scattering planes the experimental peak cross sections were found to be larger than the spectator model predictions (SIA), i.e., impossible to reproduce in the MSIA model with a positive cutoff radius. (auth)

30693 (TLU-11-73) TREIMAN–YANG TEST OF THE SPECTATOR MODEL IN THE d(p,2p)n REACTION AT 10.186 MeV. Sundqvist, B.; Johansson, A.; Amten, L.; Goenczi, L.; Koersner, I. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Apr 1973. 22p. Dep. NTIS (U. S. Sales Only) $4.25.

An experiment has been undertaken to investigate if the Treiman–Yang test reveals any deviation from the spectator-diagram reaction mechanism in the d(p,2p)n reaction at 10.186 MeV with kinematics conditions chosen close to the "quasifree" enhancement. The results indicate such a deviation, which, however, is not reproduced by a three-body calculation using separable potentials. (auth)

30694 (TLU-12-73) CALCULATION OF THE d(p,2p)n REACTION CROSS SECTION FOR LOW PROTON ENERGIES USING FIRST AND SECOND ORDER TERMS IN THE MULTIPLE SCATTERING FORMULA. Sundqvist, B.; Johansson, A. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Apr 1973. 18p. Dep. NTIS (U. S. Sales Only) $4.11.

Correlation cross sections for proton-induced deuteron breakup at low energy are calculated using first and second order terms in the multiple scattering formula. Comparisons with experimental data at T_p = 10.0 and 12.5 MeV are made. The results show that the simple reaction mechanisms assumed are inadequate and indicate that the multiple scattering series diverges. (auth)

30695 (TLU-14-73) MEASUREMENT OF THE DIFFERENTIAL CROSS SECTION FOR ELASTIC PROTON DEUTERON SCATTERING AT 10.00 MeV. Sundqvist, B.; Johansson, A.; Glantz, L. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Apr 1973. 20p. Dep. NTIS (U. S. Sales Only) $4.00.

Due to the large discrepancies in reported elastic pd data at about 10 MeV proton energy, an experiment to check the absolute cross section scale was performed. In contrast to earlier measurements using gas targets, an alternative method was used in the present experiment. Polyethylene foils with different contents of deuterium relative to hydrogen were used. The elastic pd cross section was measured relative to the pp cross section. The results are in good agreement with the results from some of the earlier measurements. (auth)

30696 (TLU-15-73) LOW-ENERGY PROTON INDUCED DEUTERON BREAKUP ANALYZED WITH THE SEPARABLE POTENTIAL MODEL. Sundqvist, B.; Johansson, A. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Apr 1973. 53p. Dep. NTIS (U. S. Sales Only) $5.75.

Experimental data from low energy proton induced deuteron breakup were analyzed with the separable potential model (SPM). The experimental data cover symmetric and asymmetric coplanar correlations and symmetric noncoplanar correlations at T_p = 10.0 MeV measured at this laboratory and symmetric coplanar correlations at T_p = 12.5 MeV measured at Rice University. The agreement between the SPM calculations of and experimental data on the correlation spectra is very good both in shape and absolute magnitude. However, systematic deviations between experimental data and SPM predictions for kinematic conditions corresponding to low relative pp energy are found, at least partly due to the neglect of Coulomb effects in the pp interaction used in the calculations. A review of the SPM model is given. (auth)

30697 (TLU-23-73) FORM FACTOR DEPENDENCE OF PROTON INDUCED DEUTERON BREAKUP AT LOW ENERGY. Ebenhoeh, W.; Sundqvist, B.; Johansson, A.; Amten, L.; Glantz, L.; Goenczi, L.; Koersner, I. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Dec 1973. 10p. Dep. NTIS (U. S. Sales Only) $4.00.

Proton-induced deuteron breakup has been studied in a kinematically complete experiment at 10.00 MeV. The precision of the data makes it possible to distinguish between calculations made with different form factors of the separable two-body forces. The Coulomb force, which is of importance in certain kinematic regions, has been included in an approximate way. The possibility to observe off-shell effects and three-body forces exists, but more experimental and theoretical work has to be done before a definite statement about these effects can be made. (auth)

30698 (TLU-24-73) d(p,2p)n CROSS SECTIONS FOR T_p = 10.00 MeV. Sundqvist, B.; Johansson, A.; Amten, L.; Glantz, L.; Goenczi, L.; Koersner, I.; Palmgren, B. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Dec 1973. 21p. Dep. NTIS (U. S. Sales Only) $4.25.

Correlation cross sections for the d(p,2p)n reaction at 10.00 ± 0.01 MeV measured at the Tandem Accelerator Laboratory, Uppsala, are listed with appropriate statistical and systematic errors. (auth)

30699 POLARIZATION OF D,D NEUTRONS FOR INCIDENCE ENERGIES ABOUT 400 keV. Schmidt, D. (Technische Univ., Dresden). Kernenergie; 16: No. 10, 328-330(Oct 1973). (In German).

The polarization of neutrons produced in the $D(d,n)^3He$ reaction was measured at deuteron bombarding energies of 300, 350, 400, and 450 keV. All the measurements were performed at a neutron emission angle of 50° in the laboratory system. The target was a Zr layer 15 mg/cm² thick on tungsten backing with a D-to-Zr ratio of 1.8. A helium polarimeter was employed for measuring the left–right asymmetry induced by elastic scattering of ^4He. The results of the present experiment indicate polarization values near −0.18. (2 figures, 1 table) (auth)

30700 POLARIZATION AND POLARIZATION TRANSFER IN THE $^2H(d,n)^3He$ REACTION AT 10 MeV. Salzman, G. C. (Los Alamos Scientific Lab., NM); Ohlsen, G. G.; Martin, J. C.; Jarmer, J. J.; Donoghue, T. R. Nucl. Phys.; A222: No. 3, 512-524(1974).

Angular distributions of six polarization transfer coefficients, $K_x^{x'}(\theta)$, $K_z^{z'}(\theta)$, $K_z^{x'}(\theta)$, $K_x^{z'}(\theta)$, $K_y^{y'}(\theta)$, and $K_{yy'}^{y'}(\theta)$; of the four analyzing powers, $A_y(\theta)$, $A_{xx}(\theta)$, $A_{yy}(\theta)$, and $A_{zz}(\theta)$; and of the polarization function, $P^{y'}(\theta)$, were measured at E_d = 10.00 MeV for the reaction $^2H(d,n)^3He$. Measurements were made for neutron lab angles between 0° and 80° in 10° steps. Additionally, the y-axis-associated quantities were measured at θ_{lab} = 99°. Most of the measured coefficients are large at some angles, and all show considerable variation with angle. (4 figures, 4 tables) (auth)

30701 FINAL-STATE INTERACTIONS AND QUASI-FREE SCATTERING IN THE $^2H(\alpha,p\alpha)n$ REACTION. Rausch, T. (Max-

Planck-Institut fuer Kernphysik, Heidelberg); Zell, H.; Wallenwein, D.; von Witsch, W. Nucl. Phys.; A222: No. 3, 429-444(1974).

The $^2H(\alpha,p\alpha)n$ reaction was studied in a kinematically complete experiment at several angles and energies suitable for observing photon-α quasi-free scattering (QFS) and proton-neutron final-state interactions (FSI). The data were analyzed in terms of various quasi-two-body models, with the strong contributions from p-α and n-α interactions in the ground states of ^{5}Li and ^{5}He, which are present in most of the spectra, taken into account. A modified impulse approximation was found to describe reasonably well the spectra dominated by p-α QFS and FSI. A characteristic increase of yield was observed in the region of low relative p-n energy; this can only be explained by the admission of at least 1% of isospin-forbidden proton-neutron FSI in the spin-singlet state. (auth)

30702 TRITON BINDING ENERGY WITH PHASE-EQUIVALENT POTENTIALS. McGurk, N. J. (Univ. of South Africa, Pretoria); Fiedeldey, H.; De Groot, H.; Boersma, H. J. Phys. Lett.; 49B: No. 1, 13-16(18 Mar 1974).

A set of phase-equivalent three-term separable potentials in the $^3S_1-^3D_1$ state has been constructed by solving the inverse scattering problem. The D-state percentage in the deuteron varies between 4 and 8%. Using a fixed two-term separable $^1S_0$ interaction these potentials produce underbinding in the triton like realistic local potentials. (auth)

30703 RELATIVE IMPORTANCE OF THE DEUTERON WAVE FUNCTION AND THE PHASE SHIFT FOR THE TRITON. Fiedeldey, H. (Univ. of South Africa, Pretoria). Lett. Nuovo Cim.; 9: No. 8, 301-307(23 Feb 1974).

It is shown that for separable potentials of rank two fixing the deuteron wave functions makes the triton binding energy insensitive to both the on-shell and off-shell T-matrix elements down to $E_{lab} \simeq 20$ MeV. It is concluded that the deuteron wave function and the low-energy phase shift are the determining factors for the triton binding energy, and that the deuteron wave function is of greater importance than the phase shift. (LBS)

30704 DYNAMICAL ASPECTS OF PHOTONUCLEAR REACTIONS BELOW PION THRESHOLD. Gari, M. (Ruhr Univ., Bochum, Ger.); Hebach, H. Phys. Lett.; 49B: No. 1, 29-32(18 Mar 1974).

The reactions (γ,p), (γ,n), (γ,pn), (γ,pp) and (γ,nn) below pion threshold are studied in view of a systematic treatment of electromagnetic meson exchange currents. As a numerical example the integrated and differential cross sections for (γ,p) and (γ,n) on ^{4}He are calculated. (auth)

30705 ELECTRIC DIPOLE SUM RULE FOR LIGHT EVEN-EVEN NUCLEI VIA BRUECKNER-HARTREE-FOCK (BHF) WAVE FUNCTIONS. Fink, M. (Ruhr Univ., Bochum, Ger.); Gari, M.; Hebach, H. Phys. Lett.; 49B: No. 1, 20-22(18 Mar 1974).

Calculations of the enhancement factor κ in the electric dipole sum done by the use of solutions of the Brueckner-Hartree-Fock (BHF) equations are presented. Results are given for ^{4}He, ^{12}C and ^{16}O for various realistic nucleon-nucleon potentials. (auth)

30706 $^2H(\alpha,\alpha p)N$ REACTION AT 165 MeV. Hourany, E.; Nakamura, H.; Takeutchi, F.; Yuasa, T. (Univ. Paris-Sud, Orsay, France). Nucl. Phys.; A222: No. 3, 537-547(1974). (In French).

A kinematically complete experiment on the $^2H(\alpha,\alpha p)n$ reaction was done by using an α-beam of 165 MeV and a liquid deuterium target. The experimental differential cross sections are compared with those calculated in the framework of the impulse approximation. The data indicate the presence of the resonance state of ^{5}He. (6 figures, 1 table) (auth)

30707 POLARIZATION OF NEUTRONS SCATTERED FROM DEUTERONS AT 120°CM. Manduchi, C.; Russo Manduchi, M. T. (Univ., Padua). Lett. Nuovo Cim.; 9: No. 13, 515-518(30 Mar 1974).

Accurate polarization data for energies of 3.4 and 7.8 MeV at a center-of-mass angle are given including the asymmetries. (JFP)

30708 POLARIZATION OF NEUTRONS FROM PROTON BREAKUP OF DEUTERIUM. Rad, F. N. College Station, TX; Texas A and M Univ. (1973). 199p. University Microfilms Order No. 74-1046.

Thesis (Ph.D.).

Measurements of the neutron polarization in the p-d breakup reaction are reported. The polarization of breakup neutrons from D(p,$\vec{n}$) was measured at $E_p = 21.4$ MeV, $\theta_{lab} = 18°$, as a function of neutron energy with an accuracy of approximately ±0.01 using a four parameter technique. The measurement is consistent with zero from 8 to 13 MeV, but shows a small but significant positive polarization from 14 to 18 MeV. A similar measurement of the breakup neutrons from the H(d,$\vec{n}$)2p reaction at the same center-of-mass momentum ($E_d = 42.8$ MeV), also at $\theta_{lab} = 18°$ shows nonzero polarization over the neutron energy region 8 to 25 MeV and peaks to about -0.05 ± 0.01. In both cases, the polarization of the breakup neutrons is opposite in sign to that expected if the dominant process is simple quasi-free scattering. (Diss. Abstr. Int., B)

30709 APPLICATIONS OF T-MATRIX PERTURBATION THEORY TO THE THREE NUCLEON PROBLEM. Siebert, B. R. L. Troy, NY; Rensselaer Polytechnic Inst. (1973). 125p. University Microfilms Order No. 74-5158.

Thesis (Ph.D.)

The accuracy of the unitary pole approximation (UPA) to the two nucleon t matrix is examined. The $(^3S_1-^3D_1)$ channel of the local soft-core Reid potential and the $(^3S_1-^3D_1)$ and $^1S_0$ channel of the two-term separable Tabakin potential are considered. The accuracy of the UPA is of similar quality for both examples. In the $(^3S_1-^3D_1)$ channel properties which depend on the S-wave part are fitted quite well, while those depending on the D-wave are not fitted quite so well. The UPA t matrix is separable. It is employed in the scheme of the Faddeev equations for the three-nucleon system, and are obtained for the three-nucleon ground state and binding energy. The difference between exact and UPA t-matrix for the Tabakin case is treated as a perturbation. T-matrix perturbation theory is used to calculate the shift in the three-nucleon binding energy. The UPA gives a value to within .32 MeV or 4.5% of the exact binding energy for Tabakin's potential. The perturbation calculation improves this value to within .06 MeV of the exact binding energy. The difference between the Yamaguchi t matrix and the UPA t matrix for the Reid potential is also treated as perturbation. The t-matrix perturbation calculation reproduced the difference in binding energy to within .01 MeV in the triplet and to within .22 MeV in the singlet channel. The UPA in conjunction with the t-matrix perturbation theory is a valuable approximation in three-nucleon ground-state calculations. (Diss. Abstr. Int., B)

30710 MICROSCOPIC STUDY OF THE FIVE-NUCLEON SYSTEM. Chwieroth, F. S. Minneapolis; Univ. of Minnesota (1973). 267p. University Microfilms Order No. 74-690.

Thesis (Ph.D.).

The five-nucleon system is studied by using the resonating-group method. In this investigation the function space is truncated so as to include the d + ^{3}He (or d + ^{3}H) and p + α (or n + α) channels. The wave functions giving the spatial behavior are chosen to approximate the eigenfunctions for the clusters and are held fixed in the calculation. A pair of coupled integrodifferential equations is solved numerically to yield the S matrix. In the first part, the one-channel approximation is made. The d + ^{3}He and d + ^{3}H systems are then studied in some detail. It is found that, due to the Pauli exclusion principle, the odd-even orbital angular momentum dependence of the phase shifts is different in the two spin states. The spin-½ channel is shown to be similar to the d + α system, while the spin-½ channel resembles the p + α system. The calculated phase shifts are examined with an R-matrix analysis. A comparison of theoretical and experimental resonance levels results in fairly good agreement. Elastic scattering cross sections are also considered. A phenomenological imaginary potential is included to allow for the loss of flux to other channels. The agreement with experimental cross sections is quite good, except at low energy (2 MeV). In the second part, the coupling terms are included. A comparison of one- and two-channel calculations shows little difference for the p + α system, but considerable difference in the d + ^{3}He system due to the fact that the deuteron is weakly bound and thus easily distorted. With the increased flexibility of the wave function, the two-channel prediction of the elastic cross section at 2 MeV is in very close agreement with experiment. A study of the differential reaction cross sections for the reactions ^{3}He(d,p)α and α(p,d)^{3}He is also made. The agreement with experimental measurements is again found to be quite good. (RWR)

30711 CHARGE FORM FACTORS OF ^{4}He AND ^{3}He WITH REALISTIC HARD CORE POTENTIALS. Katayama, T.; Akaishi, Y.; Tanaka, H. (Hokkaido Univ., Sapporo); Hiura, J. Progr. Theor. Phys. (Kyoto); 50: No. 5, 1763-1764(Nov 1973).

The charge form factors, F_{ch}, of ^{3}He and ^{4}He are investigated in terms of the wave functions Ψ determined with the Hamada-Johnston potential and Tamagaki's OPEH potentials [Progr. Theor. Phys. (Kyoto); 39: 91(1968)]. In the variational method used, Ψ is taken in a form $\Psi = F\Phi$, where F is a correlation function of a multiple-scattering type and Φ is an initial function. The nonrelativistic Born approximation is assumed. The following conclusions are noted: for ^{4}He as well as ^{3}He, F_{ch} (q^2) can be understood for lower q^2 with hard-core potentials; it seems impossible to interpret the position of the first minimum (or second maxi-

mum) on the basis of a hard-core nuclear force; for both nuclei $F_{ch}(q^2)$ for higher q^2 cannot be reproduced with the existing realistic two-body potentials. (2 figures) (RWR)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 30264, 30705, 30743, and 31044.

30712 (AD-768477-2-GA) INTEGRAL EXPERIMENT TO TEST CARBON AND NITROGEN CROSS SECTIONS. Final Report, 23 August 1971–15 August 1972. Harris, L. Jr.; Trimble, G. D.; Young, J. C. (Gulf Radiation Technology, San Diego, Calif. (USA)). 12 Sep 1972. Contract DNA001-72-C-0020. 74p. NTIS $3.50.

An integral experiment, designed to provide high sensitivity tests for gamma-ray production and neutron-scattering cross sections, was performed. The experiment is based on the white-source, pulsed-neutron, time-of-flight method with the sample at the detector end of the flight path. Measurements were made with a single 5 × 5 cm cylindrical NE-213 detector positioned at 30, 55, 90, and 125 degrees relative to the incident neutron beam. Pulse-shape discrimination was used to separate neutron and gamma-ray counts. Measured count rates due to secondary gamma rays and scattered neutrons from two sample materials, graphite and liquid nitrogen, are reported here as functions of time and incident neutron energy. Differences between calculated gamma-ray and neutron count rates and those reported should be readily interpreted in terms of specific, cross section deficiencies at well defined incident neutron energies in the 1.5- to 20-MeV range. (GRA)

30713 (COO-2167-2, pp 3-6) REACTION $^{16}O(d,^3He)^{15}N$ AT 29.0 MeV. Firestone, M. A.; Janecke, J. 1973.

In annual report, May 1, 1972–June 15, 1973.

30714 (COO-2167-2, pp 33-59) NEUTRON SPECTROSCOPY BY TIME-OF-FLIGHT. 1973.

In annual report, May 1, 1972–June 15, 1973.

30715 (COO-3071-34) STRUCTURE OF THE A = 6 NUCLEAR SYSTEM. Vergados, J. D. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 11 Jul 1973. 20p. Dep. NTIS $4.00.

The energy spectrum, electromagnetic properties, and β-decay and π^-- absorption rates of the A = 6 system are calculated by means of realistic interactions. The results are in good agreement with experiment and other theories of semileptonic weak processes. Strong π^--absorption rates are predicted for 3^- states around 20 MeV. (1 figure, 2 tables) (auth)

30716 (JINR-PA-7627) PHOTODISINTEGRATION OF ^{13}C. Asvad, A.; Eger, G. U.; Kissener, H. R.; Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 27p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.50.

The nucleon decay of the photoresonance in ^{13}C is analyzed, using bound-state shell model and R-matrix theory. Total and partial photo cross sections, branching ratios, final state population, and nucleon emission spectra are considered and compared with available data. (auth)

30717 OPTICAL MODEL PARTIAL WAVE ANALYSIS OF INTERMEDIATE ENERGY (0.6 TO 1.0 GeV) PROTON–NUCLEUS ELASTIC SCATTERING. Clark, B. C. Detroit; Wayne State Univ. (1973). 244p. University Microfilms Order No. 73-31,709.

Thesis (Ph. D.).

Elastic nucleon–nucleus scattering experiments in the intermediate energy range are described. A partial wave calculation based on the Klein–Gordon equation is described, the accuracy of the calculation is discussed, and strong evidence for its correctness is given. A sizable amount of effort was expended in the more fundamental approach in which the optical potential is related to the nucleon–nucleon scattering amplitude, restricted to energies above 100 MeV. Finally, results of the analysis of proton scattering experiments at two energies, 1 GeV and 600 MeV are given. Results for both scalar and fourth-component of a four vector optical potential are presented. The experiments at 1 GeV for p-^4He, p-^{12}C and p-^{16}O elastic scattering were reported by Palevsky et al. The experiments at 600 MeV were reported by Boschitz, et al., for p-^4He elastic scattering. It was found that the simplest optical potential from multiple scattering theory did represent the p-^{12}C and p-^{16}O experiments rather well, but was completely inadequate for p-^4He. In all cases, phenomenological optical potentials are found which fit the experimental differential cross sections and reaction cross sections. The characteristic features of the phenomenological potentials determined by the analysis are discussed. It is found that the rms radius and volume integral of the real central potential are well determined by the analysis. The effective potential, that dimensionless quantity entering the Klein–Gordon equation, exhibits a number of features. It is found that the rms radius of both real and imaginary effective potentials is well determined along with their first and second moments. It is concluded that for proper analysis of experiments in the intermediate energy range using an optical potential, complete partial wave calculations must be performed. (Diss. Abstr. Int., B)

30718 THEORY OF HEAVY ION SCATTERING. Cap, L. S. Waco, TX; Baylor Univ. (1973). 127p. University Microfilms Order No. 73-32,734.

Thesis (Ph. D.).

A theoretical study of the elastic scattering of heavy ions by the use of a complex nonlocal separable interaction is presented. This potential has a real part of rank two, which includes both an attraction and a repulsion, and an imaginary part of rank one (absorption). The Coulomb repulsion between positively charged heavy ions is explicitly included, and "Coulomb" representation of the form factors is used. Configuration space form factors are assumed of the Yukawa type. Theoretical expressions for the nuclear phase shifts, cross sections and the equivalent local potential are obtained. As an application, an analysis of the elastic ^{16}O–^{16}O scattering data is made. Four angular distributions, corresponding to the energies just above the Coulomb barrier, 12.5, 14, 15.5, and 19 MeV, are fitted. Also, five excitation functions at θ_{cm} = 49.3, 60, 69.8, 80.3, and 90 are calculated. The slopes of the experimental cross sections can be qualitatively fitted by this model. More absorption at higher energies and at larger scattering angles is needed to get more satisfactory fits to the experimental data. (Diss. Abstr. Int., B)

30719 ENERGY DEPENDENCE OF CHARGE MULTIPLICITY IN PROTON–NUCLEUS COLLISIONS AND NUCLEAR MULTIPLICITY SCALING. Friedlaender, E. M.; Marcu, M.; Nitu, R. (Inst. of Atomic Physics, Bucharest). Lett. Nuovo Cim.; 9: No. 9, 341-345(2 Mar 1974).

The mean multiplicities of fast charged secondaries produced in proton collisions with emulsion nuclei at 69 GeV were measured as a function of N_b (N_b is the number of heavily ionizing prongs, and were compared with data at 200 GeV, 6.2 GeV and 21.5 GeV. It is found that the multiplicity ratio at energies 69 and 200 GeV does not depend on either the size or the degree of excitation and/or breakup of the target nucleus, in contrast to lower energies where a strong dependence of this kind is observed. The result implies a specific nuclear multiplicity scaling. (LBS)

30720 UNEXPECTED APPARENT TRANSPARENCE OF NUCLEAR MATTER FOR HIGH ENERGY HADRONS, OBSERVED IN p–NUCLEUS COLLISION AT 200 GeV. Cohen, J. I.; Friedlaender, E. M.; Marcu, M.; Marin, A. A.; Nitu, R. (Inst. of Atomic Physics, Bucharest). Lett. Nuovo Cim.; 9: No. 9, 337-340(2 Mar 1974).

Attention is drawn to some regularities of the angular distribution of fast secondaries from collisions of 200 GeV protons in nuclear emulsions. The data is interpreted by one of the following two ways: a) either nuclear matter has an abnormally high transparency for the fast products of the first proton–nucleon collision in the nucleus, or b) this transparency is only apparent, the forward cone being absorbed and re-emitted in a multistep process. (LBS)

30721 ELASTIC SCATTERING OF α-PARTICLES ON ^{12}C AND PARITY-NONCONSERVATION EFFECTS IN ^{16}O. D'Agostino Bruno, M.; Massa, I.; Uguzzoni, A.; Vannini, G.; Verondini, E.; Vitale, A. (Univ., Bologna). Lett. Nuovo Cim.; 9: No. 8, 311-314(23 Feb 1974).

The angular distributions of elastically scattered α particles on ^{12}C were measured between 33° and 147° at 27 energies ranging from 3 to 10 MeV. The results obtained for the energy positions and widths of the 0^+ and 3^- levels relevant to parity-nonconserving effects in ^{16}O are presented, together with those of other α-^{12}C elastic scattering experiments. (LBS)

30722 USE OF THE $^{14}C(^{18}O,^{12}Be)^{20}Ne$ REACTION TO MEASURE THE MASS OF ^{12}Be. Ball, G. C.; Costa, J. G.; Davies, W. G.; Forster, J. S.; Hardy, J. C.; McDonald, A. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Lett.; 49B: No. 1, 33-36(18 Mar 1974).

The reaction $^{14}C(^{18}O, ^{12}Be)^{20}Ne$ at E = 88.7 MeV was used to measure the mass excess of ^{12}Be, the value 25.05 ± 0.05 MeV being obtained. An excited state was also observed at 2.09 ± 0.05 MeV in ^{12}Be. (auth)

30723 NUCLEAR INTERACTIONS OF 200 GeV PROTONS IN EMULSION. Barcelona-Batavia-Belgrade-Bucharest-Lund-

Lyons-Montreal-Nancy-Ottawa-Paris-Rome-Strasbourg-Valencia Collaboration. Phys. Lett.; 48B: No. 5, 467-470(4 Mar 1974).

Proton-nucleus interactions were studied in nuclear emulsion exposed to the NAL 200 GeV proton beam. The inelastic mean free path is found to be 35.5 ± 0.8 cm and the average shower particle multiplicity is 12.9 ± 0.2. The angular distribution reveals some characteristic features of proton-nucleus interactions. (auth)

30724 CALCULATIONS OF THE GIANT DIPOLE RESONANCE FOR SD-SHELL NUCLEI IN THE OPEN-SHELL RANDOM PHASE APPROXIMATION. Wong, S. S. M. (Univ. of Toronto); Rowe, D. J.; Parikh, J. C. Phys. Lett.; 48B: No. 5, 403-406(4 Mar 1974).

The systematics of the giant dipole resonance were calculated in the open-shell RPA for all the self-conjugate sd-shell nuclei, using (i) a phenomenological Rosenfeld interaction, (ii) Barret, Hewitt and McCarthy G-matrix elements and (iii) Kuo G-matrix elements. The excitations are based on shell model ground states for all nuclei except ^{28}Si for which a projected Hartree–Fock ground state was used. (auth)

30725 PION CHARGE-EXCHANGE SCATTERING ON ^{12}C. Reitan, A. Ark. Fys. Seminar Trondheim; No. 19, 1-20(1973).

The $^{12}C(\pi^+,\pi^0)^{12}N$ reaction is re-examined in the framework of the Glauber model in order to take exchange terms properly into account. Satisfactory agreement with the experiments can only be obtained if configuration mixing is introduced in the nuclear states. (auth)

30726 DUAL CORE MODEL FOR ^{10}B NUCLEUS. Narayana, K. L.; Desai, S. G. (Shivaji Univ., Kohlapur, India). J. Shivaji Univ.; 4: No. 8, 73-75(1971).

In the Born–Oppenheimer approximation, a correlated nuclear wave function was used to calculate the ground-state energy of the ^{10}B nucleus with P_k as the space exchange operator of the two outermost nucleons based on a dual core model. With a σ interaction the required strength of the short-range force is calculated to be about 30 MeV to furnish the experimental binding energy for the ^{10}B nucleus. (Indian Sci. Abstr.)

30727 FURTHER EVIDENCE OF ISOSPIN SPLITTING IN THE GIANT RESONANCE OF ^{11}B. Del Bianco, W.; Boucher, P.; Kundu, S.; Rouben, B. (Univ. of Montreal). Can. J. Phys.; 52: No. 1, 92-94(1 Jan 1974).

The 90° differential cross section of the ^{9}Be(d,γ_0)^{11}B reaction has been measured at deuteron energies from 3 to 12 MeV. The results of this experiment are consistent with a recent calculation of the dipole states of mass 11 nuclei, and with measurements of the ^{11}B(γ,nγ') and ^{11}B(γ,pγ') processes, and confirm the isospin splitting of the giant resonance in ^{11}B. (auth)

30728 SOME ASPECTS OF THE SUDDEN APPROXIMATION IN STRIPPING REACTIONS. 1. (p,d) Reactions with High Q-Values. Tanifuji, M.; Noya, H. (Hosei Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 50: No. 2, 515-528(Aug 1973).

Reactions ^{12}C(p,d)^{11}C(g.s. $\frac{3}{2}^-$), ^{16}O(p,d)^{15}O(g.s. $\frac{1}{2}^-$) and ^{16}O(p,d)^{15}O(3rd $\frac{3}{2}^-$) are studied by means of the sudden approximation, the results of which are compared with those by the DWBA calculation and with experimental data. The former theory gives better agreement with the data than the latter; this suggests that the sudden approximation gives successful results in the analysis of high Q-value reactions in the forward angular region.

30729 POLARIZATION AND CROSS SECTION STUDIES OF THE ^{12}C(^{3}He,n$_0$) AND ^{13}C(^{3}He,n$_0$) NUCLEAR REACTIONS AND OF ^{13}C(^{3}He,^{3}He) ELASTIC SCATTERING. Rhea, T. C. R. Jr. Durham, NC; Duke Univ. (1973). 149p. University Microfilms Order No. 74-1156.

Thesis (Ph.D.).

Neutron polarization and cross section angular distributions from 0° to 120° c.m. were measured from the ^{12}C(^{3}He,n$_0$)^{14}O reaction with ^{3}He bombarding energies from 8 to 22 MeV in 2 MeV steps and for the ^{13}C(^{3}He,n$_0$)^{15}O reaction at 12, 16, and 20 MeV. The neutron polarimeter utilized a spin-precession solenoid and 120° scattering from ^{4}He gas in a scintillator cell. DWBA calculations showed significant agreement with the 20- and 22-MeV ^{12}C(^{3}He,n$_0$) data, although it is evident that effects other than those described by the DWBA are present. Below 20 MeV the polarization data vary quickly with energy, and the results of the calculations are unsatisfactory. Comparison of ^{12}C(^{3}He,n$_0$) and ^{12}C(t,p$_0$) cross-section and polarization data at 16 MeV indicates that the same mechanism dominates both reactions and that the differences in the Coulomb effects for the two reactions are small. Even though the DWBA has successfully described 4 to 6 MeV ^{12}C(^{3}He,n$_0$) cross sections and polarizations, no agreement was found for the present data. The need for coupled-channel calculations is suggested. In order to derive optical-model parameters to use in the ^{13}C(^{3}He,n$_0$) DWBA calculations, the cross section and forward-angle polarization of ^{13}C + ^{3}He scattering at 19.3 MeV were measured. The data are similar to 20 MeV ^{12}C + ^{3}He scattering data, and the ^{13}C optical model parameters that were obtained were similar to those found previously for ^{12}C. (Diss. Abstr. Int., B)

30730 NEUTRON TOTAL CROSS SECTIONS OF ^{3}He, ^{4}He, ^{6}Li, ^{7}Li, ^{60}Ni, AND ^{23}Na IN THE MeV REGION. Goulding, C. A. Troy, NY; Rensselaer Polytechnic Inst. (1973). 209p. University Microfilms Order No. 74-5138.

Thesis (Ph.D.).

A measurement of the total neutron cross sections of ^{3}He, ^{4}He, ^{6}Li, ^{7}Li, ^{23}Na, and ^{60}Ni was performed at the R. P. I. Linear Accelerator by using a white neutron source and time-of-flight techniques. High-purity samples were used to insure a uniformity and a known sample thickness. A pulsed neutron source and a 252-m flight path assured good geometry (no in-scattering corrections were necessary) and resolution (~0.1 ns/m). The statistical accuracy for ^{3}He, ^{4}He, ^{6}Li, ^{7}Li was about 1% up to 15 MeV and increased to 7% at 30 MeV. The energy scale was determined to a precision of better than 0.2%. The systematic error in the magnitude of the cross sections is less than .5% with the exception of ^{60}Ni, where the systematic error is 1.2%. The ^{3}He, ^{6}Li, and ^{4}He measurements revealed no new structure. The ^{7}Li measurement revealed two new resonances with indications of two others. (Diss. Abstr. Int., B)

30731 ELECTROMAGNETIC PROPERTIES OF SPHERICAL AND DEFORMED CONFIGURATIONS IN THE K-HARMONIC MODEL OF ^{18}O. Trlifaj, L. (Inst. of Physics, Prague). Czech. J. Phys.; 24: No. 3, 249-266(1974).

There are constructed, within the framework of the K-harmonics model, the wave functions of the ^{18}O nucleus which correspond to the usual spherical configuration and to the deformed one in which the two last protons and neutrons fill the deformed orbitals belonging to the (2s–1d) shell. Matrix elements of the Coulomb interaction and of the electric multipole of order 2 are calculated. Corrections for the nonorthogonality of wave functions are negligible. Corrections for the elimination of the center-of-mass motion are surprisingly small in the Coulomb energy. They enable reduction of the effective charge usually necessary for interpreting the experimental values of the reduced E2 transition rates. The Coulomb energy is nearly independent of the deformation parameters and the other quantum numbers; E2 transition rates attain maximum values in the vicinity of their SU(3) values for 2 → 0 and 4 → 2 transitions. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 30264, 30724, 30730, 30764, 30768, 30786, 30869, and 31044.

30732 (AD-765717-4) PRELIMINARY EVALUATION OF THE NEUTRON AND PHOTON PRODUCTION CROSS SECTIONS FOR MAGNESIUM. Final Report, 1 December 1971–29 March 1973. Drake, M. K.; Fricke, M. P. (Intelcom Rad Tech, San Diego, Calif. (USA)). 11 May 1973. Contract DNA001-72-C-0036. 130p. (RT-8014-1; DNA-3130-F). NTIS $4.50.

A brief description is given here of previous preliminary results for evaluated neutron and photon-production cross sections for natural magnesium. These data were contributed in ENDF/B-3 formats to the Radiation Shielding Information Center at Oak Ridge National Laboratory and have been assigned the material identification number MAT 4512 (Mod. 0). The methods and data references used, and uncertainty estimates for the evaluated data, nuclear-model parameters used to supplement experimental data, and plots of the evaluated data are given. (GRA)

30733 (JINR-P15-7682) STUDY OF THE ENERGY AND ANGULAR DEPENDENCE OF THE SPIN-FLIP PROBABILITY AT INELASTIC SCATTERING OF PROTONS ON ^{24}Mg. Golubev, S. L.; Kurepin, A. B.; Likhosherstov, V. N.; Osetinskii, G. M.; Faruk, M. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The energy and angular dependence of the spin-flip probability and that of the differential cross section of the inelastic proton scattering near the resonance energies of 2.41 and 4.02 MeV in the ^{24}Mg(p,p'γ)^{24}Mg reaction were measured. The angular distribution of the inelastic proton scattering in the resonance region of 2.41 MeV is isotropic in the c.m.s., which proves the main contribution of S wave in the entrance channel. The spin-flip probability is also isotropic, of nonresonance character and equals (14 ± 3)%. The spin-flip probability near the 4.02 MeV resonance is of nonresonance character and equals (35 ± 4)%. (auth)

30734 (LBL-2360) HIGH-RESOLUTION STUDIES OF BETA-DELAYED PROTON EMISSION IN LIGHT NUCLEI. Sextro, R. G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 173p. Dep. NTIS $11.75.

Thesis.

Identified protons were observed following beta decay of the precursor nuclei ^{21}Mg, ^{25}Si, ^{37}Ca, ^{40}Sc, ^{41}Ti, and ^{23}Al. These measurements spanned a proton energy range from 600 keV to 8.5 MeV, and included all significant particle decays of these nuclei. A helium-jet transport system was developed and used with various $\Delta E-E$ counter telescopes to obtain high-resolution, low-background spectra. These data permitted accurate location of proton unbound levels in the beta-decay daughters, and absolute branching ratios and ft values for these allowed decays were determined. The half-lives of these nuclei were measured, and all except that for ^{41}Ti are consistent with the previous values. For ^{41}Ti, the half-life is 80 ± 2 msec, which differs from the old value of 88 ± 1 msec. This latter value is thought to have been affected by the presence of ^{37}Ca activity produced in a competing reaction. The ft values for ^{21}Mg and ^{25}Si are compared to the negatron decay rates in their respective mirrors. For mass 21, $(ft)^+/(ft)^- = 1.10 \pm 0.08$, while for mass 25 this ratio is 1.17 ± 0.04. A comparison of predicted and observed beta-decay rates for the superallowed decay to the $T = 3/2$ state in ^{41}Sc indicates that this level has an isospin impurity of ~6%. The observed beta-decay rates in ^{21}Mg and ^{37}Ca are also contrasted with theoretical predictions for decay rates to their respective daughters. The calculated values agree well for ^{21}Mg, while for ^{37}Ca the calculations appear to be limited by the basis space used. Delayed protons from ^{23}Al, the first member of the A = 4 n + 3 series of $T_z = 3/2$ nuclei, were observed, and the half-life of ^{23}Al was measured to be 470 ± 30 msec. In addition, delayed protons from ^{40}Sc were studied in order to ascertain their contribution to the proton spectra obtained from ^{3}He bombardment of ^{40}Ca. (32 figures, 25 tables, 135 references) (auth)

30735 (ORO-3820-24, pp 6-7) BETA-NEUTRINO CORRELATIONS IN THE DECAY OF ^{20}Na. Macfarlane, R. D.; Torgerson, D. F.; Nickles, R. J. 15 Jan 1974.

In on-line alpha and proton decay spectrometry.

The study of beta-neutrino correlations in neon-20 decay covers the momentum dependence of the longitudinal nuclear alignment of the beta recoils, coherence of the helicity states of the beta, and Coulomb effects. (JFP)

30736 ENERGIES, DECAY SCHEMES, AND LIFETIMES OF LEVELS IN ^{34}Ar MEASURED USING THE ^{32}S(^{3}He,nγ)^{34}Ar REACTION. Bell, R. A. I.; Thompson, J. V.; Graham, I. G.; Carlson, L. E. (Australian National Univ., Canberra). Nucl. Phys.; A222: No. 3, 477-492(1974).

Energies, γ-ray decay schemes, and lifetimes of levels in ^{34}Ar were measured using the DSAM and a neutron-gamma coincidence technique. Levels were populated by the ^{32}S(^{3}He,n) reaction with an 8-MeV ^{3}He beam and a thick, cooled sulfur target. A method of correcting observed $F(\tau)$ values for γ-ray cascades is described. The excitation energies and lifetimes deduced are 2091.1 ± 0.3 keV (330 ± 80 fs), 3287.7 ± 0.5 keV (215 ± 70 fs), 3873 ± 3 keV, 4127.8 ± 1.0 keV (<350 fs), and 4513.2 ± 0.8 keV (390 ± 180 fs). The measured lifetimes are on average 1.6 times longer than reported elsewhere for experiments using an Ag_2S target; this discrepancy is discussed in the light of Broude's recent observations of DSAM lifetime dependence on stopping material. The ratio of isovector to isoscalar charge was calculated for twelve E2 transitions in 4n + 2 nuclei of the 2s1d shell and found to imply almost equal effective proton and neutron charges. (1 figure, 5 tables) (auth)

30737 PHOTOPROTON CROSS SECTION FOR ^{26}Mg IN THE GIANT DIPOLE RESONANCE REGION. Variamov, V. V.; Ishkhanov, B. S.; Kapitonov, I. M.; Piskarev, I. M.; Shevchenko, V. G.; Shevchenko, O. P. (Moscow State Univ.). Nucl. Phys.; A222: No. 3, 548-556(1974).

The ^{26}Mg(γ,xp) reaction cross section was obtained in the excitation energy region up to 29 MeV by using bremsstrahlung from the 35-MeV betatron. The role of isospin splitting in the formation of a giant dipole resonance is discussed in the case of light nuclei. (5 figures, 1 table) (auth)

30738 ROTATOR-PARTICLE p-WAVE NEUTRON RESONANCES IN THE COMPOUND NUCLEUS ^{29}Si. Choi, B. H. (Univ. of North Carolina, Chapel Hill); Divadeenam, M. Lett. Nuovo Cim.; 9: No. 9, 375-380(2 Mar 1974).

An attempt is made to interpret ^{29}Si neutron resonances within the framework of the Nilsson model employing the Feshbach formalism. The target ^{29}Si is described as a deformed rotator and the compound nucleus is treated in a rotator-particle coupling scheme. The model predicts only one strong resonance for both $1/2^-$ and $3/2^-$ spins and no s-wave resonance above neutron threshold. A comparison of experimental and predicted reduced-width sum for spins $3/2^-$ and $1/2^-$ up to 2 MeV neutron energy shows satisfactory agreement. (LBS)

30739 DIFFERENT COUPLING INTERACTIONS IN SEMI-DIRECT CAPTURE OF 14 MeV NEUTRONS BY Si, Sr, Ce, AND ^{208}Pb. Longo, G. (Comitato Nazionale Energia Nucleare, Bologna); Saporetti, F.; Rigaud, F.; Irigaray, J. L.; Petit, G. Y. Nuovo Cim.; 20A: No. 2, 373-390(21 Mar 1974).

Gamma-ray spectra following the capture of 14 MeV neutrons by Si, Sr, Ce and ^{208}Pb are compared with the predictions of semi-direct theory. All the values for the input parameters are taken from experimental data independent of the γ-ray experimental spectra examined. It is found that for nuclei in different mass regions the volume form of the coupling interaction is more adequate than the surface form to account for the available experimental data. (auth)

30740 BACKWARD-ANGLE ANOMALIES IN ALPHA-PARTICLE ELASTIC SCATTERING. Boridy, E. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett.; 48B: No. 5, 413-416(4 Mar 1974).

The backward-angle anomalies in elastic alpha-particle scattering were recently attributed to exchange processes such as heavy-particle stripping and knock-on. Using a parameter-free treatment, it is shown that the so far neglected one-particle exchange arising from the antisymmetrization between the projectile and the target nucleus is important and should be considered in any quantitative analysis of the anomalous alpha-backscattering. (auth)

30741 ESTABLISHMENT OF THE EXISTENCE AND INVESTIGATIONS OF THE $J^\pi = 6^-$, T = 1 STATE AT Ex = 14356 keV OF ^{28}Si. Miehe, C.; Gonidec, J. P.; Huck, A.; Walter, G. (CERNS, Strasbourg). Rev. Phys. Appl.; 8: No. 4, 307-310(Dec 1973). (In French).

The ^{27}Al(p,γ)^{28}Si reaction at E(p) = 2876 ± 2 keV was used to study the virtual state $J^\pi = 6^-$, T = 1 at Ex = 14356 keV, and the antianalogue bound level, $J^\pi = 6^-$, T = 0 at E(x) = 11577 keV of ^{29}Si. The resonant level de-excitation scheme was established. The characteristics of the two new states were determined from angular distribution and Doppler shift lifetime measurements. The intensity of the resonance was determined ($\omega\gamma = 3 \pm 1$ eV). The results enable a definition to be obtained for the de-excitation of the 14356-keV level in terms of an M1, $\Delta T = 1$ transition having a strength of 0.5 Weisskopf units. The ^{27}Al(p,p)^{27}Al elastic scattering measurements were used to confirm the parity of the resonant level. (auth)

30742 BAND MIXING IN THE 2s-1d SHELL: APPLICATION TO ^{23}Na. Haas, B.; Taras, P. (Univ. of Montreal). Can. J. Phys.; 52: No. 1, 49-60(1 Jan 1974).

Formulas treating correctly hole excitations and the j^2 term in the context of the strong coupling collective model are presented. It is found that such a treatment gives rise to appreciable differences from the usual band mixing calculations of nuclei in the 2s-1d shell. As an illustration, the nucleus ^{23}Na is discussed. This nucleus, with a large ground state quadrupole moment, seems to be an ideal candidate for the application of the unified model. Although the model reproduces the energy level scheme quite well, it fails, rather badly, to explain the observed electromagnetic transition properties of a number of levels. (auth)

30743 HARTREE-FOCK ALPHA CLUSTER DENSITY DISTRIBUTIONS IN LIGHT A = 4n NUCLEI USING DENSITY DEPENDENT EFFECTIVE INTERACTIONS. Lassey, K. R. (Univ. of Melbourne, Parkville, Australia); Manning, M. R. P.; Volkov, A. B. Can. J. Phys.; 51: No. 24, 2522-2549(15 Dec 1973).

Hartree-Fock calculations have been performed for the A = 4n nuclei ^{12}C to ^{40}Ca, employing a selection of density-dependent effective interactions. This selection consists of two density and momentum dependent delta function interactions, similar to the Skyrme interaction, and two density and momentum dependent finite-range interactions whose radial forms are given as a sum of two Gaussian functions. A basis of single-particle axially deformed harmonic oscillator functions is used. Special emphasis is given to the study of the occurrence of alpha-particle type clustering in the density distributions of light A = 4n nuclei and the influence of the strength of the one-body spin-orbit field. (auth)

30744 EXCITED STATES OF ^{30}P USING THE REACTION ^{29}Si(p,γ)^{30}P. Malik, A. J. Corvallis, OR; Oregon State Univ. (1974). 87p. University Microfilms Order 73-32,767.

Thesis (Ph.D.).

The ^{29}Si(p,γ)^{30}P reaction was used to study the excited states in ^{30}P populated by the γ decay of the resonance states at E_p = 2040, 2084, 2125, 2234, and 2410 keV. The branching ratios of

these resonance states to the bound states in ^{30}P were determined. A new level at 5.58 MeV is proposed; this level is excited by the γ decay of the 2040-keV resonance. The level at 4343 keV, populated by the γ-decay of the 2410-keV resonance, has not previously been studied in any (p,γ) resonance experiments. Precision γ-ray energy measurements at E_p = 2040 and 2125 keV resonances yielded the energies of the bound states of ^{30}P with excitation energies (in keV) as follows: 677.4 ± 0.5; 709.2 ± 0.5; 1454.6 ± 0.5; 1973.7 ± 0.7; 2539.2 ± 1.0; 2724.0 ± 0.5; 2839.9 ± 1.0; 2938.2 ± 1.0; 3020.1 ± 0.5; 3836.2 ± 1.2; 4183.2 ± 1.2; 4422.0 ± 2.0; 4736.7 ± 1.0; 4938.5 ± 1.0; 5206.6 ± 2.0; 5507.1 ± 1.0; 5576.9 ± 2.0; 5702.3 ± 1.0. The Q value of the reaction ^{29}Si(p,γ)^{30}P was determined to be Q = 5591.5 ± 3 keV. The Doppler-shift attenuation method (DSAM) was used to measure, or place limits on, lifetimes of several states in ^{30}P with excitation energies E_x < 5.8 MeV. The measured lifetimes (in fs) are as follows: 2539-keV level (262 ± 10), 2724-keV level (190 ± 25), 2839-keV level (2200 ± 800), 3020-keV level (<21), 3836-keV level (52 ± 8), 4183-keV level (<20), 4343-keV level (220 ± 25), 4422-keV level (62 ± 8), 4736-keV level (90 ± 14), 4939-keV level (<15), 5206-keV level (30 ± 15), 5507-keV level (<10), 5577-keV level (<21), and 5702-keV level (<21). The results obtained are compared with earlier measurements and nuclear-model calculations. (RWR)

30745 NUCLEAR SPECTROSCOPY VIA THE (p,p'γ) REACTION. Gearhart, N. L. Jr. Columbus, OH; Ohio State Univ. (1973). 231p. University Microfilms Order No. 74-3174.

Thesis (Ph. D.).

The spins and parities of resonances in ^{29}P and the isobaric analogs of states in ^{51}Ti were studied. Excitation functions for the inelastic scattering of protons to the first excited states of ^{28}Si(2^+, 1.78 MeV) from 3.10–5.20 MeV bombarding energy and for ^{50}Ti(2^+, 1.55 MeV) from 3.60–4.60 MeV bombarding energy were measured at 90° in the center-of-mass system. Triple angular correlations for the ^{28}Si(p,p'γ)^{28}Si and ^{50}Ti(p,p'γ)^{50}Ti reactions were performed in the Goldfarb–Seyler geometry over the prominent resonances in the excitation functions. Spin and parity assignments were made for nine of the eleven observed resonances in ^{29}P and for three of the five observed states in ^{51}Ti. (Diss. Abstr. Int., B)

30746 ALPHA CAPTURE TO THE GIANT QUADRUPOLE RESONANCE. Foote, G. S.; Branford, D.; Shikazono, N.; Weisser, D. C. (Australian National Univ., Canberra). J. Phys., A (London); 7: No. 3, L27-L31(11 Feb 1974).

Angular distributions have been measured for the reaction ^{28}Si(α,γ$_0$)^{32}S in the energy range E_α = 12 to 18 MeV; and the cross sections for exciting 1^- and 2^+ states, deduced. These data together with similar data for ^{28}Si and ^{40}Ca are compared to calculations made using Hauser–Feshbach theory. It is shown that the (α,γ) reaction most probably excites the giant quadrupole resonance. (auth)

30747 CROSS SECTIONS AND ANGULAR DISTRIBUTIONS IN THE ^{23}Na(n,n'γ) REACTION AND STUDY OF MAGNETIC SUBSTATE POPULATIONS. Donati, D. R. Lowell, MA; Lowell Technological Inst. (1973). 138p. University Microfilms Order No. 74-2309.

Thesis (Ph. D.).

The ^{23}Na(n,n'γ)^{23}Na reaction was employed to obtain neutron inelastic-scattering cross sections for six levels in ^{23}Na over the incident neutron energy range from 0.52 to 4.23 MeV. These cross sections were determined by using the measured gamma-ray production cross sections for the ten de-excitation gamma rays. The gamma rays were detected at 125° with respect to the incident neutron beam by using a 40-cm^3 Ge(Li) detector. Ge(Li) time-gating was used, with pulsed-beam neutron time-of-flight techniques. A neutron time-of-flight monitor and a long counter calibrated by means of a proton recoil detector were employed to monitor the neutron flux. Corrections were applied to the data to take Ge(Li) detector efficiency and finite sample size into account. Gamma-ray angular distributions were obtained at various incident neutron energies between 0.73 and 3.82 MeV. The magnetic substate populations were evaluated from the Legendre-expansion coefficients, and the results compared with theoretical predictions. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 30724, 30734, 30743, 30745, 30746, 30764, 30765, 30768, 30786, 30836, 30860, 30869, and 31044.

30748 (FRNC-TH-452) ELASTIC SCATTERING OF 21 TO 29.6 MeV α PARTICLES ON NUCLEI IN THE Ti–Zn REGION. Lemos, O. F. (Paris-11 Univ., 91–Orsay (France)). 1972. 117p. (In French). Dep. NTIS (U.S. Sales Only) $9.00.

Thesis.

The elastic scattering of α particles was studied together with the corresponding optical model. Isotopically enriched targets of ^{46}Ti, ^{50}Cr and ^{52}Cr, ^{54}Fe and ^{56}Fe, ^{58}Ni, ^{60}Ni, ^{62}Ni, and ^{64}Ni, and ^{64}Zn were irradiated with 21-, 23-, 25-, and 29.6-MeV α particles. The data obtained agree with the simple diffraction model. In particular, none of the anomalous scattering effects observed in the elastic scattering on calcium appeared. The classical discrete and continuous ambiguities were observed in the analysis with the nuclear optical model. An exhaustive study was made on the explicit form of the potential and the number of parameters necessary to describe it. A potential with an imaginary volume part, four parameters, and r_0 approximately equal to 1.37 fm leads to angular distributions which are in good agreement with experimental results. The depth of real wells was chosen to be in the 200 MeV region. The optical potential surface seems to be more important than the inside of the nucleus in fitting experimental data. No energy dependence was found in the energy range studied. At a given energy, no simple variation of the potential as a function of the mass of the target exists. No variation in $Z/A^{\frac{1}{3}}$ or $A^{n/3}$ (n, an integer) occurs. The depth of the imaginary well varies linearly with the nuclear asymmetry parameter (N – Z)/A (isospin effect). The depth of the real well seems to vary more erratically, and it is not possible to find a simple parametrization which provides a good agreement in a coherent manner for all the data. (auth)

30749 CALCULATION OF THE NUCLEAR PROPERTIES OF ^{53}Mn BY THE INTERMEDIATE-COUPLING UNIFIED MODEL. Chung, W. H. (Univ. of Alberta, Edmonton, Can.). Z. Phys.; 266: No. 1, 1-5(1974).

The properties of the low-lying excited states of ^{53}Mn have been investigated in the framework of the intermediate-coupling unified nuclear model. In the present calculations, it was assumed that three holes in the $1f_{\frac{7}{2}}$ proton shell, which undergo excitations, are coupled to the quadrupole vibrations of the doubly even core. Energy levels and electromagnetic properties have been calculated. In most cases, the results are found to be in good agreement with the experimentally observed values for the low-lying excited states in ^{53}Mn. The results are also compared with those obtained from other models. (2 figures, 5 tables) (auth)

30750 CIRCULAR POLARIZATION AND γ–γ ANGULAR CORRELATION MEASUREMENTS IN THE ^{39}K(n,γ)^{40}K REACTION. Op den Kamp, A. M. F. (FOM–RCN Nuclear Structure Group, Utrecht). Nucl. Phys., A222: No. 2, 388-398(1974).

Circular polarization measurements of the γ-radiation from polarized neutron capture combined with γ–γ angular correlation measurements in the ^{39}K(n,γ)^{40}K reaction lead to $J^\pi = 2^-$ assignments to the E_x = 0.80, 2.05 and 2.42 MeV states of ^{40}K, and to spin restrictions for the states at E_x = 2.10, 3.44 and 4.25 MeV. Multipole mixing ratios for the γ-rays which de-excite these levels were determined. (auth)

30751 STRENGTHS OF (p, γ) RESONANCES IN ^{33}Cl, ^{35}Cl, AND ^{28}Si. Aleonard, M. M.; Boursiquot, C.; Hubert, P.; Mennrath, P. (CEN de Bordeaux, Gradignan, France). Phys. Lett.; 49B: No. 1, 40-42(18 Mar 1974).

Absolute strength measurements were performed for the E_p = 580 and 588 keV ^{32}S(p, γ)^{33}Cl, E_p = 1214 keV ^{34}S(p, γ)^{35}Cl and E_p = 633 and 744 keV ^{27}Al(p, γ)^{28}Si resonances with a Ge(Li) detector. Results are discussed with regard to the decay of isobaric analog resonances in ^{35}Cl and ^{37}Cl. (auth)

30752 ANOMALOUS L = 0 TRANSITION OBSERVED IN THE REACTION ^{40}Ca(p, t)^{38}Ca. Kubono, S.; Kato, S.; Yasue, M.; Ohnuma, H.; Ogawa, K. (Tokyo Univ). Phys. Lett.; 49B: No. 1, 37-39(18 Mar 1974).

An anomalous L = 0 transition to the 3.06 MeV state in ^{38}Ca is observed in the reaction ^{40}Ca(p, t) at E_p = 52 MeV. Its angular distribution and relative intensity can be explained by the cancellation of form factors. (auth)

30753 STRUCTURE OF THE GROUND STATES OF NICKEL ISOTOPES AND THE EFFECTIVE INTERACTIONS IN THE 2p–1f SHELL. Sharma, S. K. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett.; 49B: No. 1, 5-7 (18 Mar 1974).

The HFB calculations are carried out for the even–even Ni isotopes, employing the Kuo–Brown effective interaction for the 2p–1f shell, modified slightly so as to satisfy certain constraints imposed on it by the BE2(0 → 2) systematics in the shell. Quite contrary to the results obtained in some earlier calculations, the conventional approach of assuming $1f_{7/2}$ sub-shell closure for protons as well as neutrons is seen to be valid to a good extent for Ni isotopes. (auth)

30754 MEASUREMENT OF NEUTRON INELASTIC SCATTERING CROSS SECTIONS FOR ^{51}V AND ^{55}Mn. Correia, J. A. Lowell, MA; Lowell Technological Inst. (1973). 143p. University Microfilms Order No. 74-2300.

Thesis (Ph.D.).

A system was developed to measure fast-neutron inelastic scattering cross sections by using the (n,n'γ) technique. Background reduction was accomplished by using shielding, pulsed beam methods, and, to a limited extent, Compton suppression. Corrections to the data for finite-sample effects and geometric effects of the beam were made. Neutron flux and Ge(Li) detector efficiency were directly measured. Excitation function measurements were made on ^{51}V in the energy range from 1.0 to 5.0 MeV and on ^{55}Mn in the range 1.0 to 3.8 MeV, and angular distribution measurements were made at three energies for each element. Neutron inelastic scattering cross sections were inferred from these measurements. Hauser–Feshbach theoretical calculations for series of assumed spins were made and compared with the experimental results to yield spin and parity assignments for several levels in each of the above-mentioned nuclei. (Diss. Abstr. Int., B)

30755 NUCLEAR SPECTROSCOPY OF ^{49}V UP TO 4 MeV. Rozsa, C. M. Columbus, OH; Ohio State Univ. (1973). 238p. University Microfilms Order No. 74-3305.

Thesis (Ph.D.).

The reaction ^{46}Ti(α,pγ)^{49}V at 10 MeV incident α energy was used to populate the excited states of ^{49}V. The gamma decay of states up to 4 MeV was investigated to determine the energies of these states to better than 2 keV. A previously unobserved level was found at 2178 keV, and the decay scheme of 16 states from 2671 to 3973 keV was determined. The mean lifetimes of 20 states up to 2671 keV were measured or limited by the Doppler Shift Attenuation method (DSAM) in two different geometries, the one designed specifically for lifetime measurements and the other designed for particle–gamma correlation investigations. Data to deduce spins and mixing ratios was taken in the Litherland and Ferguson method II geometry with an annular surface barrier detector at 180° to the beam direction. All of the obtained spectroscopic information together with the results of other investigators was combined to deduce or limit the spins and parities of states up to 4 MeV. Eighteen of the 36 states are delineated as having a contribution to the wave function from an s or d hole. The remaining 18 states are compared with the theoretical calculations of Malik and Scholz and of McCullen, Bayman and Zamick, which do not include excitations of the ^{40}Ca core. (Diss. Abstr. Int., B)

30756 CHARGED PARTICLES PRODUCED IN THE BOMBARDMENT OF ^{45}Sc BY 45 MeV PROTONS. Spitzer, H. Los Angeles; Univ. of Southern California (1973). 179p. University Microfilms Order No. 74-945.

Thesis (Ph.D.).

In an attempt to study clustering in the ^{41}Sc nucleus, targets of ^{45}Sc were bombarded with protons of 45 MeV incident energy. A detector telescope composed of four solid state charged particle detectors made possible the identification and measurement of deuterons, tritons, ^{3}He, ^{4}He, ^{6}He, ^{6}Li, and ^{7}Li particles. Energy-integrated differential cross sections were calculated for ranges of excitation in the residual nuclei. Reactions leading to the ranges of lowest excitation energy appear to be direct in nature, while those leading to ranges of high excitation energy were found to be more like compound-nucleus reactions. Differential cross sections were calculated for reactions leading to single states of the various residual nuclei. These were found to proceed via a direct mechanism and were compared with theoretical predictions based on the distorted-wave Born approximation. For the (p,^{4}He) reaction, large numbers of low-energy ^{4}He particles were observed and compared to a Monte Carlo evaporation calculation. The (p,^{6}Li) and (p,^{7}Li) cross sections were found to be substantially larger than the (p,^{4}He) reaction cross section, despite the fact that the latter can proceed without disturbing the ^{40}Ca core, while the former two cannot. The mechanism involving the pickup of an alpha particle-like cluster from the ^{40}Ca core was postulated and shown to give reasonable DWBA results for the (p,^{6}Li) and (p,^{7}Li) ground-state reactions. More evidence for this mechanism was found in the comparison of ^{45}Sc and ^{46}Ti measured cross sections. (Diss. Abstr. Int., B)

30757 LEVELS OF ^{56}Fe EXCITED BY THE (p,p'γ) AND (n,n'γ) REACTIONS. Lachkar, J.; Sigaud, J.; Patin, Y.; Haount, G. (Centre d'Etudes, Bruyeres-le-Chatel, France). Nucl. Phys.; A222: No. 2, 333-364(1974). (In French).

The energy levels of ^{56}Fe were studied by means of the (p,p'γ) and (n,n'γ) reactions. Particle–gamma coincidences from the ^{56}Fe(p,p'γ) reaction were measured at 6.5, 8, 10, and 11 MeV incident proton energies. The coincident γ rays were detected with a 100-cm^3 Ge(Li) detector, and protons, with cooled Si(Li) diodes. Independently, absolute differential cross sections for the production of γ rays by inelastic neutron scattering from iron were measured in the energy range 4.8 to 8.8 MeV. A 65-cm^3 Ge(Li) detector surrounded by a NaI(Tl) annulus and associated with a pulsed-beam time-of-flight system was used to detect the de-excitation γ rays. By comparing the measured angular distributions and excitation functions with those calculated on the basis of the statistical theory, spin assignments for poorly known states were made. From these two experiments, a decay scheme was constructed and proposed. The results are briefly compared with mixed-configuration shell-model calculations. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 30719, 30720, 30723, 30730, 30739, 30748, 30767–30769, 30785, and 30795.

30758 (AD-765711-7) PRELIMINARY EVALUATION OF THE NEUTRON AND PHOTON PRODUCTION CROSS SECTIONS FOR COPPER. Final Report, 1 December 1971–29 March 1973. Drake, M. K.; Fricke, M. P. (Intelcom Rad Tech, San Diego, Calif. (USA)). Contract DNA001-72-C-0036. 94p. (RT-8014-2; DNA-3129-F). NTIS $3.75.

A brief description is given of the preliminary results for evaluated neutron and photon-production cross sections for natural copper. The data were contributed in ENDF/B-3 formats to the Radiation Shielding Information Center at Oak Ridge National Laboratory and were assigned the material identification number MAT 4529(Mod. 0). The methods and data references used, and uncertainty estimates for the evaluated data, nuclear-model parameters used to supplement experimental data, and plots of the evaluated data are given. (GRA)

30759 (COO-2167-2, pp 7-10) NUCLEAR STRUCTURE IN THE N=50 ISOTONES. Neff, G.; Gray, W. S. 1973.

In annual report, May 1, 1972–June 15, 1973.

30760 (JINR-E7-7636) QUASIMOLECULAR KX-RAY EXCITATION BY BOMBARDMENT OF Ge ATOMS WITH Ge IONS. Gippner, P.; Kaun, K. H.; Stary, F.; Schulze, W.; Tret'yakov, Yu. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 12p. Dep. NTIS (U.S. Sales Only) $4.00.

By bombardment of Ge targets with $^{74}_{32}$Ge^{5+} ions of 81 MeV a continuous x-ray intensity distribution was obtained, which ranges up to the Kx-ray energies of Gd. The shape of the spectra corrected for the detector efficiency confirms the assumption that this continuum is caused by Kx-rays of Z = 64 quasimolecules which are transiently formed during the adiabatic heavy ion collision. The yield of quasimolecular radiation was determined to be about 3.10^{-5} per beam K-vacancy. (auth)

30761 (JINR-P2-7687) PRODUCTION OF HIGH ENERGY PIONS IN DEUTERON–NUCLEUS COLLISIONS ACCORDING TO IMPULSE APPROXIMATION MODEL. Gerasimov, S. B.; Giordeneskii, N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Based on the model of impulse approximation with the account of the Fermi motion of nucleons in nuclei the calculation of the inclusive cross section of the high energy pion production in the deuteron-nucleus collisions was performed. The comparison with experiment shows that taking into account of the Fermi motion cannot explain the observed value of the "cumulative" meson production. The experimental cross section is by more than the order of magnitude greater than the results of a theoretical model. (auth)

30762 GAMMA DECAY OF ANALOG STATES IN ^{61}Cu. Trentelmann, J. P.; Leslie, J. R.; McLatchie, W. (Queen's Univ., Kingston, Ont.). Z. Phys.; 266: No. 1, 60-74(Jan 1974).

Resonances in the reaction ^{60}Ni(p,γ)^{61}Cu have been studied in the proton energy ranges E_p = 1,840–1,880 keV and 2,220–2,300 keV. Decay schemes and branching ratios have been determined for a number of resonances, three of which are identified as analog fragments of the 283 keV ($^1/_2^-$) and 656 keV ($^5/_2^-$) states in ^{61}Ni. The split analog components of the 283 keV state at $E_x \approx$ 6.6 MeV are seen to decay significantly to a group of states in the region of excitation 3–4 MeV. Gamma ray angular distributions yield the following resonance spins: E_p = 2,248 keV, J = $^3/_2$; E_p = 2,263 keV, J = $^5/_2$. Also, the ^{61}Cu ground state β^+ decay to parent levels in ^{61}Ni has been compared to the respective analog state M1 gamma decay to the ^{61}Cu ground state. (5 figures, 6 tables) (auth)

30763 PRODUCTION OF ENERGETIC He NUCLEI AND TRITONS IN 24 GeV/c PROTON INTERACTIONS WITH Ag AND Br NUCLEI. Irfan, M.; Zafar, M.; Naqvi, A. H.; Ansari, A. R.; Shafi, M. (Aligarh Muslim Univ., India). Nuovo Cim.; 20A: No. 2, 354-362(21 Mar 1974).

708 stars with $N_h \geq 7$ were analyzed to study the production mechanism of fast He nuclei and tritons. On the basis of the D-distribution for He nuclei, it is concluded that the majority of the He nuclei in the momentum range (0.6 to 1.5) GeV/c are ^{3}He. The frequencies of emission of tritons and He nuclei were observed to be nearly equal. The shape of the energy spectrum of ^{3}He nuclei is similar to the one obtained for tritons. It is suggested that the pick-up as well as the pion absorption by nuclear α-clusters present near the nuclear surface may be operating in the production of these particles. (auth)

30764 (n,^{3}He) REACTIONS AT 14.6 MeV ON MEDIUM AND HEAVY MASS NUCLEI. Qaim, S. M. (Kernforschungsanlage, Juelich, Ger.). J. Inorg. Nucl. Chem.; 36: No.2, 239-244(Feb 1974).

(n,^{3}He) reaction cross-sections have been measured at E_n = 14.6 ± 0.4 MeV for ^{45}Sc, ^{59}Co, ^{75}As, ^{93}Nb and ^{181}Ta, and upper cross-section limits have been established for ^{31}P and ^{115}In. The activation technique in combination with specific radiochemical methods was employed. The measured cross-sections lie between 2 and 10 μbarn. They do not show any strong dependence on Z, N or A of the target nuclei; only a very slight decrease in cross-section is observed with increasing relative neutron excess (N − Z)/A of the target. Possible mechanisms of the (n,^{3}He) reaction are discussed. (auth)

30765 CROSS SECTION CALCULATION RELEVANT TO FUSION REACTOR. I. (n,2n) Reaction. Ohta, M. (Kyushu Univ., Fukuoka); Nakashima, H.; Nishihara, H. Kyushu Daigaku Kogaku Shuho; 46: No. 3, 295-299(Jun 1973). (In Japanese).

The (n,2n) reaction cross-section was calculated for various materials which are used for the blanket of fusion reactors. By using the statistical model of nuclei, the continuous evaporation process of two neutrons was assumed for the calculation. An empirical formula by Flerov and Talysin was used for the non-elastic cross-section, and a level density parameter a (MeV^{-1}) was assumed to be $a = 0.154\ (\bar{J}_Z + \bar{J}_N + 1)\ A^{\frac{1}{3}}$, where $\bar{J}_N$ and $\bar{J}_Z$ are effective spin values of neutron shell and proton shell, respectively, and A is atomic number. The (n,2n) cross-section obtained for Nb, Mo, V and Ni isotopes is shown. The cross-section for Mo is larger than that for Nb in the energy range lower than 14 MeV. Thus, it is considered that Mo is better material for vacuum chambers than Nb. Experimental values of the (n,2n) reaction cross-section of natural Mo scarcely exist, and precise experiment is required. The calculated values for the Nb(n,2n) reaction are larger than experimental values. This discrepancy can be reduced by considering the branching of the (n,2n) reaction to ground state and first-excited state. The absorption cross-sections such as (n,p), (n,α) and (n,γ) were small as compared with the (n,2n) cross-section. These reactions, however, effect on tritium on tritium breeding, and are important from the viewpoint of radiation damage. The (n,2n) cross-section for Ni and V is small and these metals are not suitable for the vacuum chambers of fusion reactors. (JA)

30766 SHELL MODEL AND COLLECTIVE EXCITATIONS IN ^{72}Ge. Castel, B.; Micklinghoff, M.; Johnstone, I. P. (Queen's Univ., Kingston, Ont.). Can. J. Phys.; 51: No. 23, 2403-2406 (1 Dec 1973).

The importance of core excitations in the shell-model structure of ^{72}Ge is investigated in a model which couples two neutrons in the $p_{\frac{1}{2}}$ and $g_{\frac{9}{2}}$ subshells to the low-lying excitations of ^{70}Ge. Particle excitations from the $p_{\frac{3}{2}}$ and $f_{\frac{5}{2}}$ subshells are taken into account through second-order perturbation diagrams. Satisfactory agreement is obtained for energy levels and E2 and E0 rates in ^{72}Ge in a calculation involving essentially two parameters. (auth)

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Refer also to abstracts 29536, 30524, 30682, 30684, 30719, 30720, 30723, 30739, 30763–30765, 30835, 30844, and 31245.

30767 (ANCR-1129, pp 3-5) INTEGRAL CAPTURE CROSS SECTION MEASUREMENTS OF FISSION PRODUCT ISOTOPES (CFRMF). Harker, Y. D.; Nisle, R. G.; Turk, E. H.; Berreth, J. R. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

30768 (ANCR-1129, pp 20-22) EVALUATION OF DECAY SCHEMES FOR ILRR. Helmer, R. G.; Greenwood, R. C. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

30769 (ANCR-1129, pp 23-31) GAMMA-RAY ENERGY AND RELATIVE INTENSITY MEASUREMENTS OF SEVERAL FISSION PRODUCT RADIONUCLIDES. Gehrke, R. J.; McIsaac, L. D.; Heath, R. L. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

30770 (CONF-740105-1) INITIAL UNISOR RESEARCH: NEW ISOTOPES ^{186}Tl, ^{188}Tl, ^{116}I; DECAYS OF ^{189,190}Tl, ^{117}Xe, AND ^{117}I; AND OFF-LINE ATOMIC AND NUCLEAR STUDIES. Hamilton, J. H.; Spejewski, E. H.; Mlekodaj, R. L. (UNISOR, Oak Ridge, Tenn. (USA)). 1974. 40p. Dep. NTIS $4.00.

From 24th annual national conference on nuclear spectroscopy and structure of the atomic nucleus; Kharkov, USSR (29 Jan 1974).

This conference contribution reports the first research studies carried out on UNISOR, in the summer and fall of 1973. New results on the decays of the known isotopes ^{189}Tl, ^{190}Tl, ^{116}Xe, and ^{117}Xe → ^{117}I → ^{117}Te are presented, and studies on the new isotopes ^{116}I, ^{188}Tl, and ^{186}Tl are reported. Off-line work on nuclear g-factor measurements and atomic physics experiments is also included. (11 figures, 2 tables) (RWR)

30771 (COO-2167-2) ANNUAL REPORT, MAY 1, 1972 – JUNE 15, 1973. (Michigan Univ., Ann Arbor (USA)). Cyclotron Lab.). 1973. Contract AT(11-1)-2167. 97p. Dep. NTIS $8.00.

Work during the period was devoted to completing the new beam line and neutron tunnel, to completing a program of cyclotron modification and orbit studies, to continuing the investigations of the spectroscopy of the rare earth region and in-beam γ spectroscopy, and to the development of the neutron time-of-flight system. Information is presented under the following headings: experimental program; cyclotron modifications, beam diagnostics, and orbit studies; and facilities improvements. (RWR)

For title listing of selected papers see: 30713, 30714, 30759, 30772, and 30803.

30772 (COO-2167-2, pp 29-33) IN-BEAM γ-RAY SPECTROSCOPY. Bardwick, J.; Griffin, H. C.; Hull, K. L.; Tickle, R. S. 1973.

In annual report, May 1, 1972–June 15, 1973.

30773 (FRNC-TH-450) STUDY OF NEUTRON STRENGTH FUNCTIONS AND THE OPTICAL MODEL AT VERY LOW ENERGIES. Delaroche, J. P. (Paris-11 Univ., 91-Orsay (France)). 1972. 105p. (In French). Dep. NTIS (U.S. Sales Only) $8.25.

Thesis.

Reactions induced by low energy neutrons in the compound nucleus resonance domain (E(n) between 12 and 350 eV) were studied. The S_0 strength functions (for neutrons having an angular momentum l = 0) are compared; these functions are proportional, in a first approximation, to the cross section for the formation of the compound nucleus averaged over a large energy interval. In spite of the fact that measurements intended to establish the existence of a variation in the S_0 strength function with spin were not entirely successful, the experimental results can be interpreted using an optical model if a real spin–spin potential is included in the Hamiltonian of the (A + 1) neutron system. Analysis led to the conclusion that the spin–spin interaction is small and that its intensity, V(ss), is less than 500 keV; the values of V(ss) obtained are in good agreement with those determined from experimental analysis in which the target and neutron beam are polarized. Tin, tellurium, and xenon isotopes are used as examples to explain the decay of S_0 strength functions with mass number when a complex interaction between the isospin of the incident neutron and the isospin of the target nucleus is included in the Hamiltonian of the system (neutron + nucleus). Systematic studies of the S_0 strength functions is followed up using the coupled channel optical model to obtain a better understanding of the variations in the experimental value of S_0 with mass number. (FR)

30774 (JUL-1003-AC(Vols. 1,2,3)) GAMMA-RAY LINES OF THE RADIONUCLIDES. Volumes 1, 2, and 3. Erdtmann, G.; Soyka, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Analytische Chemie). Sep 1973. 1151p. (In German and English). Dep. NTIS (U. S. Sales Only) $53.00.

This table contains a complete listing of all γ-emitting radionuclides and of all their γ lines. In addition, it contains all other lines observable with a γ-ray spectrometer, i.e., the 511-keV

lines of the positron annihilation radiation, the escape lines generated in connection with pair production processes of high energy γ quanta, and most of the x-ray lines correlated to radioactive decay. Beside the energies, the intensities of the lines are given as far as data have been found in the cited references. If it has been possible to find or to calculate the absolute intensity of the γ lines, these values are given, since they are usually more valuable in practical applications. The radionuclide data are supplemented by data concerning their half-life, parent and daughter nuclides, and generating reactions. In the first part of the table the radionuclides with their γ lines are arranged in order of increasing atomic and mass number; the second part contains the γ lines of all radionuclides arranged according to their energy. This part of the table is primarily designed to analyze γ-ray spectra of radionuclide mixtures containing unknown components; therefore, the data for each γ line are accompanied by some supplementary statements to facilitate the affiliation of a γ line to a certain radionuclide. Weak γ lines were not included. (auth)

30775 (ORO-3820-24) ON-LINE ALPHA AND PROTON DECAY SPECTROMETRY. Annual Progress Report, 1973. Macfarlane, R. D. (Texas Agricultural and Mechanical Univ., College Station (USA)). 15 Jan 1974. Contract AT(40-1)-3820. 19p. Dep. NTIS $3.00.

Experimental research on the determination of the properties of beta recoils and recoil-surface interactions is summarized. A list of publications is included. One section is abstracted separately. (JFP)

For an abstract of an individual section see: 30735.

30776 (RCN-205) RCN-1 PSEUDO FISSION-PRODUCT CAPTURE GROUP CROSS SECTIONS. Gruppelaar, H. (comp.). (Stichting Reactor Centrum Nederland, Petten). Jan 1974. 34p. Dep. NTIS (U.S. Sales Only) $4.75.

A summary of the results obtained on pseudo fission-product cross sections for four mixtures, representing fission products of ^{235}U, ^{238}U, ^{239}Pu, and ^{241}Pu, in the fast breeder reactor SNR-300 is presented. Group cross sections for neutron capture were calculated and checked against reactivity worths of three mixed fission-product samples, measured in four neutron spectra in the STEK facility. A reasonable agreement was found, and statistical adjustment of the cross section did not lead to significant changes. A comparison was made of pseudo fission-product cross section sets, derived from an RCN evaluation and several other data files. (2 figures, 8 tables) (auth)

30777 MAGNETIC MOMENT AND HALF-LIFE OF THE ISOMERIC $11/2^-$ STATE IN ^{107}Cd. Bertschat, H.; Haas, H.; Pleiter, F.; Recknagel, E.; Schlodder, E.; Spellmeyer, B. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys., A222: No. 2, 399-404(1974).

An isomeric level in ^{107}Cd at 845 keV populated by the reactions ^{107}Ag(p,n), ^{106}Cd(d,p) and ^{104}Pd(α,n) was observed. The half-life of this state is $T_{\frac{1}{2}} = 77(7)$ns, and the spin and parity are $I^\pi = 11/2^-$. The magnetic moment was determined by the pulsed beam time-differential perturbed angular distribution method (DPAD) to be $\mu = -1.012(12)$ n.m. (auth)

30778 ISOSPIN CONSERVATION AND PRE-EQUILIBRIUM DECAY IN (p,p') REACTIONS ON NEUTRON RICH TIN ISOTOPES. Kalbach-Cline, C. (Univ. of Rochester, NY); Huizenga, J. R.; Vonach, H. K. Nucl. Phys., A222: No. 2, 405-428(1974).

Energy spectra for protons emitted in (p,p') reactions on ^{118}Sn, ^{120}Sn and ^{124}Sn were studied as a function of emission angle at incident energies of 14.0 and 17.8 MeV. These data confirm the importance of isospin selection rules in such reaction systems. While it is not possible to make any definite statements about the mechanism of the reactions populating the higher isospin intermediate states, it is possible to obtain a consistent description of the observed spectra in terms of two pre-equilibrium decay components, one each for the $T_>$ and $T_<$ states in the composite system. Small $T_<$ evaporation peaks for the ^{119}Sn and ^{120}Sn systems may be present. While this explanation is critically dependent on the validity of the extended Griffin model used in the analysis, it is a direct consequence of the inclusion of isospin in the model using techniques adopted from equilibrium calculations. The high energy protons, which have forward-peaked angular distributions, are attributed to pre-equilibrium decay of the $T_<$ states and are predicted to be emitted fairly early in the equilibrium process. The model also predicts that $T_>$ state pre-equilibrium decay should occur primarily toward the end of equilibration and identifies such processes with the low energy, isotropically emitted protons observed in the data. However, the enhanced rate of proton emission from the $T_>$ composite states may result in a breakdown of the fundamental statistical assumption of equal population for all n-exciton $T_>$ states. On the basis of the statistical model analyses performed it is estimated that 40 to 80% of the $T_>$ states undergo proton emission before isospin mixing occurs and that virtually none of them reach statistical equilibrium. (auth)

30779 STUDY OF 4 GeV ELECTRON SPALLATION PRODUCTS OF IODINE-I. Karim, H. M. A. (Liverpool Univ.). Radiochim. Acta; 19: No. 1, 1-4(1973).

Iodine targets have been irradiated with 4 GeV electrons and the products of (e,e'xn), (e,e'pxn), (e,e'2pxn) and (e,e'3pxn) reactions have been measured by gamma spectrometry. The decay characteristics of ^{126}I, ^{124}I, ^{123}I, ^{121}I, ^{120}I, ^{123m}Te, ^{121m}Te, ^{119m}Te, ^{119}Te, ^{117}Te, ^{116}Te, ^{122}Sb, ^{120}Sb, ^{118m1}Sb, ^{117}Sb and ^{110}Sn have been discussed. (3 figures, 1 table) (auth)

30780 DELAYED NEUTRON EMISSION FROM THE DECAY OF NEUTRON-RICH Rb AND Cs ISOTOPES. Roeckl, E.; Dittner, P. F.; Klapisch, R.; Thibault, C.; Rigaud, C.; Priels, R. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France). Nucl. Phys.; A222: No. 3, 621-628(1974).

The delayed-neutron emission probability, P_n, and the half-lives of the new delayed neutron precursors ^{97}Rb, ^{98}Rb, ^{142}Cs, and ^{146}Cs were measured by using an on-line mass spectrometer. The P_n values of the known $^{93-96}$Rb were remeasured, and an upper limit was found for the β-delayed double-neutron emission probability of ^{96}Rb. The experimental P_n values for $^{97-98}$Rb are discussed in a simple semiempirical picture. (auth)

30781 DEFORMED STATES OF NEUTRON-DEFICIENT CERIUM AND NEODYMIUM NUCLEI. Gizon, J.; Gizon, A.; Maier, M. R.; Diamond, R. M.; Stephens, F. S. (Univ. of California, Berkeley). Nucl. Phys.; A222: No. 3, 557-578(1974).

High-spin levels in Ce and Nd isotopes excited by the reactions ^{120,122}Sn(^{16}O,3n) ^{133,134}Ce and ^{122,124}Te(^{16}O,3n) ^{135,137}Nd were studied by in-beam γ-ray spectroscopic methods (prompt and delayed spectra, excitation functions, angular distributions and γ-γ coincidences). Bands built on the $11/2^-$ isomeric levels in ^{135}Ce and ^{137}Nd and on the $9/2^-$ ground states in ^{133}Ce and ^{135}Nd were found. A prolate deformation is required for these nuclei in order to explain the E2/M1 mixing ratios and the level ordering of these bands. (11 figures, 4 tables) (auth)

30782 MEASUREMENT OF (n,p) CROSS SECTIONS ON ISOTOPES OF Cd, Sn, AND Te FOR 14 MeV NEUTRONS. Struwe, W.; Winkler, G. (Institut fuer Radiumforschung und Kernphysik, Vienna). Nucl. Phys.; A222: No. 3, 605-613(1974).

For several isotopes of Cd, Sn and Te, cross sections for the (n,p) process were measured by activation relative to ^{27}Al(n,α)^{24}Na. As target materials natural Cd, Sn, and TeO_2 of high purity were used. Measurements were carried out by γ detection by using a Ge(Li) detector. For measuring short-lived activities a pneumatic tube system was used. The neutron energy was 14.6 ± 0.2 MeV for all activations. The results obtained for the total (n,p) cross sections show decreasing values with increasing number of neutrons for a given proton number. This trend obviously follows the behavior of the difference of the proton and neutron separation energies, determining the competition between proton and neutron emission. (1 figure, 4 tables) (auth)

30783 9.38 GeV/c DEUTERON STRIPPING ON PHOTOEMULSION NUCLEI. Dalkhazhav, N. (Joint Inst. for Nuclear Research, Dubna, USSR); Shabratova, G. S.; Tolstov, K. D.; Adamovich, M. I.; Larionova, V. G. Nucl. Phys.; A222: No. 3, 614-620(1974).

The interaction of relativistic deuterons with photoemulsion nuclei was investigated. The photoemulsion method makes it possible to measure precisely small angles between relativistic particles in reactions and to select unambiguously the events of inelastic deuteron absorption. Proton stripping in the interaction of 9.38-GeV/c deuterons was investigated. (4 figures, 1 table) (auth)

30784 OBSERVATIONS OF NEUTRON INDUCED ANALOG RESONANCES. Hicks, G. C.; Legge, G. J. F. (Univ. of Melbourne, Parkville, Australia). J. Phys., A (London); 7: No. 3, L32-L35(11 Feb 1974).

Resonant structure has been observed in the zirconium total neutron cross section and in the ^{90}Zr(n,p) excitation function. It is interpreted as being due to states in ^{91}Zr which are isobaric analogues of the low-lying states in ^{91}Y. (auth)

30785 EFFECTIVE NUCLEON–NUCLEON INTERACTIONS AND ENERGY LEVELS OF THE NUCLEI ^{89,90,91,92,93,94}Sr AND ^{89,90,91,92,93,94,95}Y. Wakimuru, K. (Kochi Univ., Japan). Progr. Theor. Phys. (Kyoto); 50: No. 3, 1082-1084(Sep 1973).

Matrix elements of the effective n–n and p–n interactions were determined for the $(2d_{5/2})^2$ and $(2p_{1/2})_p \times (2d_{5/2})_n$ configurations, respectively, and the energy levels of $^{89-94}$Sr and $^{89-95}$Y were calculated in the shell model. A ^{88}Sr core was assumed, and the effective two-body matrix elements and single-particle energy

were determined by least-squares fitting of experimental spectra. (1 figure, 2 tables) (RWR)

30786 MEASUREMENT OF AVERAGE CROSS SECTIONS FOR SOME THRESHOLD REACTIONS BY MEANS OF A SMALL FISSION FOIL IN LARGE THERMAL NEUTRON FIELD. Kimura, I.; Kobayashi, K.; Shibata, T. (Kyoto Univ., Kumatori, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 9, 574-577(Sep 1973).

A method by which difficulties inherent in absolute measurement and the perturbation of the fission neutron spectrum by the return neutron flux from material surrounding the fission plate can be obviated is described and applied to the measurement of average cross sections of some threshold reactions. A foil of 90% enriched U–Al alloy, about 0.5 mm thick and 1 cm in diameter, was fixed on the periphery of a thin Al rotor plate with some threshold foils. Diagonally across the plate similar threshold foils were placed, but without the U–Al foil. The assembly was irradiated in a large room. The reaction rate can be expressed by using the shape factor or calculated by the Monte Carlo method. Cross sections for the following reactions are tabulated and compared with previous results: $^{58}Ni(n,p)^{58}Co$, $^{27}Al(n,\alpha)^{24}Na$, and $^{115}In(n,n')^{115m}In$. (2 figures, 2 tables) (RWR)

30787 THERMAL NEUTRON ACTIVATION CROSS SECTIONS AND RESONANCE INTEGRALS OF ^{94}Zr AND ^{96}Zr. Santry, D. C.; Werner, R. D. (Chalk River Nuclear Labs., Ont.). Can. J. Phys.; 51: No. 23, 2441-2443(1 Dec 1973).

The activation method was used to determine thermal neutron activation cross sections, σ_0, and resonance integrals, RI. Values obtained were $\sigma_0 = 47.5 \pm 2.4$ mb, RI = 218 ± 10 mb for ^{94}Zr and $\sigma_0 = 22.9 \pm 1.0$ mb, RI = 5.20 ± 0.54 b for ^{96}Zr. Calculations were based on the Westcott convention and the known cross sections for the ^{59}Co and ^{197}Au neutron flux monitors. Measurements confirmed the existence of a p-wave neutron resonance capture for ^{96}Zr. The half-life of ^{97}Zr was measured as 16.90 ± 0.05 h. (auth)

30788 TWO-NEUTRON TRANSFER REACTIONS ON NUCLEI AROUND N = 82 CLOSED SHELL. Toki, H.; Sano, M. (Osaka Univ., Toyonaka, Japan). Progr. Theor. Phys. (Kyoto); 50: No. 2, 699-701(Aug 1973).

The superfluid model was used to calculate the ground-state to ground state reactions on Zr and Nd isotopes. The calculated and experimental cross sections for (p,t) reactions leading to the ground states of the Nd isotopes are shown explicitly; agreement of varying quality is obtained for different cases. In order to reproduce the experimental values for the Zr and Nd isotopes, the energy interval between the levels above and below the closed shell must be taken smaller than that obtained from the separation energies. The data indicate the necessity of taking into account the change in the nuclear deformations of the target and residual nuclei. Calculated angular distributions are in good agreement with experimental data. The success in reproducing the experimental cross sections for two-neutron transfer reactions suggests that the Nd isotopes, except for ^{142}Nd, are in the superfluid phase. These superfluid properties may arise from couplings between the valence protons and neutrons. (2 figures, 1 tables) (RWR)

30789 $1g_{\frac{9}{2}}$ NEUTRON STATE IN NUCLEI WITH NEUTRON NUMBERS BETWEEN 52 AND 82. Ishimatsu, T. (Tohoku Univ., Sendai); Hayashibe, S.; Awaya, T.; Ohmura, H. J. Phys. Soc. Jap.; 35: No. 6, 1579-1585(Dec 1973).

Spectra of deuterons from (p,d) reactions on 18 nuclei with neutron numbers N between 52 and 82 were measured at an angle of 20° with 52-MeV incident protons. In each spectrum a broad bump with the distinct top is observed at excitation energies of several MeV or higher. From the systematic behavior of the bump it is inferred that the top of the bump stands for an approximate position of the $1g_{\frac{9}{2}}$ neutron state, and energies of this state are estimated from the observed spectra. The estimated energies are compared with calculated ones and a reasonable agreement is obtained. The systematics of the energy difference between the top of the bump and the ground state in the residual nucleus is discussed on the basis of the simple pairing theory, and results which are well consistent with the above interference about the top of the bump are obtained. (auth)

30790 COMPARISON OF SUB-COULOMB (d,p) STRIPPING AND ANALOG RESONANCE RESULTS FOR THE N = 82 ISOTONES. Norton, G. A. Columbus, OH; Ohio State Univ. (1973). 157p. University Microfilms Order No. 74-3278.

Thesis (Ph.D.).

Angular distributions were measured for (d,p) reactions below the Coulomb barrier on ^{139}La, ^{140}Ce, ^{141}Pr, ^{142}Nd, and ^{144}Sm. From these angular distributions, reduced normalizations, which are insensitive to the bound-state neutron well parameters, were extracted by using a DWBA analysis following the method of Rapaport and Kerman. These reduced normalizations are compared with those extracted from analogs of low-lying states of ^{140}La, ^{141}Ce, ^{142}Pr, ^{143}Nd, and ^{145}Sm by using the technique of Clarkson, von Brentano, and Harney. The purpose of this comparison is to decide among three analog resonance theories: the shell-model approach of Mekjian and McDonald; the R-matrix approach of Thompson, Adams, and Robson; and a different shell-model method of Zaidi, Darmodjo, and Harney. (Diss. Abstr. Int., B)

30791 NUCLEAR HARTREE–FOCK CALCULATIONS IN A DEFORMED BASIS. Tuerpe, D. R. Davis, CA; Univ. of California (1973). 121p. University Microfilms Order No. 73-21,884.

Thesis (Ph.D.).

Self-consistent nuclear calculations were performed with the Tabakin potential in an axially deformed harmonic oscillator basis. The basis is big enough to permit calculations of nuclear structure through the rare earth nuclei. It is shown that expansion of the nuclear wave functions in a deformed basis is a necessity for the self-consistent calculation of heavy deformed nuclei, and some representation calculations for medium weight nuclei are exhibited. The constrained Hartree–Fock method is then used to supply a foundation for the Strutinsky-Nilsson method of obtaining nuclear energy-deformation surfaces. The Strutinsky-Nilsson solution for ^{100}Ru is tested in various ways by comparison with a constrained Hartree–Fock calculation. It is shown that the shell corrections obtained with the Strutinsky renormalization procedure may be in error by as much as 2 MeV or 25%. (Diss. Abstr. Int., B)

30792 L-SUBSHELL FLUORESCENCE YIELDS FOR SILVER AND TELLURIUM. Derman, S. New York; New York Univ. (1973). 139p. University Microfilms Order No. 74-1873.

Thesis (Ph.D.).

By means of a Bragg spectrometer employing recently developed mosaic crystals of graphite the L x-ray spectrum of radioactive ^{125}I and ^{109}Cd was measured. Both these isotopes decay by the process of K and L electron capture to form the daughter elements tellurium and silver respectively. In addition, the fluorescence L x-ray spectra of both tellurium and silver, obtained by bombarding thin samples of these materials with electromagnetic radiation from a commercial, chromium anode x-ray tube were measured. From these spectra, the relative intensities of the major transitions to the L-shell were determined by a computer aided curve fitting technique. Using these results, plus available data for Coster Kronig yields and average L-shell fluorescence yields, the three individual L-subshell fluorescence yields, ωL_1, ωL_2, and ωL_3 for tellurium and silver were determined. The experimentally determined results agree reasonably well with the theoretically predicted values. (Diss. Abstr. Int., B)

30793 INVESTIGATION OF POSSIBLE PERTURBATION OF $\gamma-\gamma$ DIRECTIONAL CORRELATIONS. Sarper, M. R. Atlanta; Georgia Inst. of Tech. (1973). 99p. University Microfilms Order No. 74-235.

Thesis (Ph.D.).

$\gamma-\gamma$ directional correlations in ^{154}Gd, ^{125}Te, ^{153}Eu, and ^{143}Pr that proceed through levels of lifetimes 1.2, 1.5, 3.8, and 4.2 nsec, respectively, were studied with the application of a magnetic field parallel to one radiation in order to search for possible attenuation of the correlations. Attenuations were found for the 1270 to 123 keV cascade in ^{154}Gd (in general agreement with earlier work) and in ^{143}Pr, both of which have very large magnetic susceptibilities. No attenuation was found for the 427 to 35 keV cascade in ^{125}Te and the isotropic correlation found for the 70 to 103 keV cascade in ^{153}Eu is inferred to be the true correlation. The inferred unattenuated correlation coefficient for the 293 to 57 keV cascade in ^{143}Pr is $A_2 = 0.18 \pm 0.02$. The evidence for the relevant spin assignments in ^{143}Pr is reviewed. (Diss. Abstr. Int., B)

30794 STUDY OF SPHERICAL NUCLEI BY EQUATIONS-OF-MOTION METHOD. Praharaj, C. R. Pittsburgh; Carnegie-Mellon Univ. (1973). 100p. University Microfilms Order No. 74-4728.

Thesis (Ph.D.).

The equations-of-motion method of Kerman and Klein is applied to the study of nuclear states in the cadmium region. Both even and odd nuclei are considered. The solution to the equations are the various one-particle transfer amplitudes $\langle \beta J;A+1||a_j^\dagger||\ I;A\rangle$ or $\langle \beta J;A-1||a_j||\ I;A\rangle$. For many active nucleons both these amplitudes should be studied together, and there should be self-consistency between the even and the odd nuclei. Only the initial steps of such a self-consistent theory are studied. Results of calculation for odd-proton nuclei Ag and Rh are given. The role of Pauli Principle in these calculations is emphasized, and the $\frac{1}{2}^+$ "intruder" level is satisfactorily explained. Also, two-body matrix elements of the Kallio–Koltveit force are evaluated for the cadmium region. (Diss. Abstr. Int., B)

30795 SINGLE-NUCLEON TRANSFER REACTIONS IN Br AND Mo ISOTOPES. Cheung, H. C. Montreal; McGill Univ. (1973). National Library of Canada, Ottawa.
Thesis (Ph. D.).
The ^{94,96,98,100}Mo(^{3}He,d)^{95,97,99,101}Tc and ^{79,81}Br(d,p)^{80,82}Br reactions were investigated with an 18-MeV ^{3}He beam and a 12-MeV deuteron beam from tandem accelerators. Measurements were performed using ΔE−E silicon detector telescopes and an Enge split-pole magnetic spectrograph. For the detector telescope method, techniques of "range−energy" electronic charged-particle identification were employed. A total of 198 low-lying states in ^{95,97,99,101}Tc and ^{80,82}Br were identified. Most of these states were observed for the first time. The differential cross section angular distributions of 127 of the observed states were analyzed with the DWBA theory; the l-transfer values, spectroscopic factors and spin−parity assignments for the levels were deduced. The results were interpreted in terms of the shell model using the spectroscopic sum rules. The observed nuclear systematics and the deduced target nucleus configurational structure were discussed. (Diss. Abstr. Int., B)

30796 MASS EXCESSES OF ^{91}Tc AND ^{90}Tc. Iafigliola, R.; Gujrathi, S. C.; Tracy, B. L.; Lee, J. K. P. (McGill Univ., Montreal). Can. J. Phys.; 52: No. 1, 96-97(1 Jan 1974).
The isotopes ^{91}Tc and ^{90}Tc have been identified by β- and γ-ray spectroscopy. The ^{91}Tc ground state decays with a half-life of 3.12 ± 0.05 min, and has been assigned a J^{π} of $9/2^{+}$. Two isomers in ^{90}Tc with half-lives of 7.9 ± 0.2 s and 50 ± 2 s have been identified for the first time. The J^{π} for the 7.9 s isomer has been deduced as 1^{+}. The mass excess for ^{91}Tc has been determined to be −76.0 ± 0.2 MeV, and the mass excess corresponding to the 7.9 s isomer in ^{90}Tc has been determined to be −71.2 ± 0.2 MeV. (auth)

30797 PENETRATION EFFECT AND TRANSITION PROBABILITY OF THE $\frac{5}{2}^{+} \rightarrow \frac{7}{2}^{+}$ TRANSITION IN ^{135}La. Morinaga, A.; Akiba, M.; Fujioka, M.; Nakayama, H.; Sekikawa, M.; Hisatake, K. (Tokyo Inst. of Tech.). J. Phys. Soc. Jap.; 35: No. 4, 1251 (Oct 1973).
In order to obtain the penetration parameter of the 87-keV (M1 + E2) transition, the internal conversion coefficients were measured. The results obtained were $\alpha_K = 1.18 \pm 0.06$, $\alpha_{L_1} = 0.110 \pm 0.007$, and $K/L_1 = 11.2 \pm 0.4$. The penetration parameter of the 87-keV transition was determined to be $\lambda = 19 \pm 4$, and the E2/M1 mixing ratio was simultaneously determined to be $\delta^2 = 0.26 \pm 0.02$. In addition, the lifetime of the 206-keV level was found to be (0.50 ± 0.05) ns. The branching ratio of the 87-keV to the 206-keV transition was 0.132 ± 0.009; and the total conversion coefficient of the 87-keV transition, 1.60 ± 0.08. The penetration matrix element for the latter transition was thus $|M_c| = (3.2 \pm 0.7)\mu_N$. This value is too large to be explained by current nuclear models. (1 figure) (RWR)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 29527, 30764, 30767, 30768, 30770, 30773, and 30793.

30798 (ANCR-1129, pp 33-39) EVEN−PARITY STATES IN ^{178}HF FROM THE ^{177}Hf(n,γ) REACTION. Greenwood, R. C.; Reich, C. W. Dec 1973.
In Nuclear Technology Division annual progress report for period ending June 30, 1973.

30799 (ANCR-1129, pp 40-42) STUDIES OF THE ^{168}Yb (n,γ) REACTION. Greenwood, R. C.; Reich, C. W. Dec 1973.
In Nuclear Technology Division annual progress report for period ending June 30, 1973.

30800 (ANCR-1129, pp 47-57) LEVEL STRUCTURE OF ^{184}W FROM DECAY OF ^{184g}Re AND ^{184m}Re. Greenwood, R. C.; Reich, C. W.; Helmer, R. G.; McMillan, D. J. Dec 1973.
In Nuclear Technology Division annual progress report for period ending June 30, 1973.

30801 (ANCR-1129, pp 58-65) E3 TRANSITION PROBABILITIES AND QUASIPARTICLE−PHONON MIXING IN ^{184}W. Reich, C. W. Dec 1973.
In Nuclear Technology Division annual progress report for period ending June 30, 1973.

30802 (ANCR-1129, pp 66-72) LEVEL STRUCTURE OF ^{184}W FROM THE ^{183}W(n,γ) REACTION. Greenwood, R. C.; Reich, C. W. Dec 1973.
In Nuclear Technology Division annual progress report for period ending June 30, 1973.

30803 (COO-2167-2, pp 11-29) SPECTROSCOPY OF THE RARE-EARTH REGION. Broad, A. S.; Lewis, D. A.; Splett, J. A.; Gray, W. S.; Bardwick, J.; Parkinson, W. C. 1973.
In annual report, May 1, 1972−June 15, 1973.

30804 NUCLEAR LEVELS IN ^{160}Tb. Kern, J. (Univ., Fribourg, Switzerland); Mauron, G.; Michaud, B.; Schreckenbach, K.; von Egidy, T.; Mampe, W. Nucl. Phys., A221: 333-370(1974).
The high-energy γ-ray spectrum from thermal-neutron capture in natural terbium was studied over the energy range of 5200 to 64pp keV. Low energy γ radiation of the same reaction was observed from 20 to 1230 keV, and conversion electrons were observed from 6 to 160 keV. Low energy (n,γγ) coincidences were measured. A value of 6375.1 ± 0.3 keV was obtained for the neutron binding energy in ^{160}Tb. The data, when combined with a previous ^{159}Tb (d,p) study, allow a level scheme to be constructed. These levels are assigned to nine rotational bands built on two quasi-particle configurations. The decay of several other levels is discussed. In three cases both parallel and antiparallel coupled bands with $K^{-} = |\Omega_p - \Omega_n|$ and $K^{+} = \Omega_p + \Omega_n$ were observed, and the Gallagher−Moszkowski rule was found to be valid. The energy splitting was calculated by using Nilsson wave functions and a δ-force. Two K = 1 bands with irregular level spacing were observed. (auth)

30805 LOW-SPIN STATES OF ^{153}Gd OBSERVED IN THE DECAY OF ^{153}Tb. Tuurnala, T.; Siivola, A.; Jartti, P.; Liljavirta, T. (Univ. of Helsinki). Z. Phys.; 266: No. 2, 103-116 (Jan 1974).
Level structure of the 89-neutron nucleus ^{153}Gd has been investigated by studying the EC decay of isotope-separated ^{153}Tb sources with several semiconductor detectors. In addition to singles gamma and electron spectra, γ−γ and e⁻−γ coincidences were investigated by using Ge(Li) and Si(Li) spectrometers and a high-capacity two-parameter recording system. In all, 191 γ-rays are assigned to the decay of the 2.4 d ^{153}Tb. The proposed level scheme of ^{153}Gd, containing most of the observed transitions, shows a very high density of low-spin states (45 states below 1.5 MeV). Spin and/or parity assignements, based mainly on coincidence data and measured transition multipolarities, are proposed for a majority of these states. Nilsson-model classifications of some levels are discussed. On the basis of log ft values the spin and parity of the ground state of ^{153}Tb are suggested to be $\frac{3}{2}^{+}$ or $\frac{5}{2}^{+}$. (6 figures, 2 tables) (auth)

30806 NEUTRON STRENGTH FUNCTIONS IN RARE EARTH NUCLEI. Back, B. B.; Bang, J.; Bjoernholm, S.; Hattula, J.; Kleinheinz, P.; Lien, J. R. (Univ. of Copenhagen). Nucl. Phys., A222: No. 2, 377-387(1974).
The coupling of the single particle motion of the neutron to other degrees of freedom is studied by the (d,p) reaction leading to highly excited states in rare earth nuclei. Experimental spectra were obtained with a telescope counter system for 13 rare earth isotopes of Gd, Dy, Er and Yb. The results are compared with calculations based upon the single particle model in a deformed Saxon-Woods potential. The spreading of the single particle strength resulting from the coupling to other degrees of freedom is taken into account in a simple phenomenological way. A qualitative similarity between the experimental and calculated spectra is observed, and the total integrated (d,p) cross section up to the neutron binding energy is reproduced quite closely by the calculations. For a given excitation energy, the amount of structure in the experimental spectrum seems to decrease with neutron number for each element investigated. (auth)

30807 HIGH SPIN NEGATIVE PARITY STATES IN DOUBLY EVEN Hg, Pt, AND Os NUCLEI. Yates, S. W.; Cunnane, J. C.; Hochel, R.; Daly, P. J. (Purdue Univ., Lafayette, IN). Nucl. Phys., A222: No. 2, 302-332(1974).
A systematic study of the level structure of ^{190}Hg, ^{192}Hg, ^{194}Hg, ^{194}Pt, ^{192}Pt, ^{190}Pt, ^{188}Os, ^{194}Os and ^{192}Os was performed by means of (α, 2nγ) and (p,2nγ) in-beam γ-ray spectroscopy. Much new information was obtained about the individual level spectra, and arguments based on level energy and population intensity systematics were used to trace the behavior of interesting spectral features through this series of transitional nuclei. Of particular interest is a 5^{-}, 7^{-}, 9^{-} ... sequence of levels which appears to be a recurring feature in the spectra of the doubly even Pt and Hg nuclei in the mass range A = 190 to 200. These negative parity levels are connected by enhanced E2 transitions and they are very strongly populated in the de-excitation of the residual nuclei formed in (α,2n) reactions. It is proposed that the 5^{-}, 7^{-},

9^- ... sequences constitute rotation-aligned bands analogous to the decoupled bands identified by Stephens and co-workers in odd-A transitional nuclei. In the doubly even nuclei, the bands may arise from the coupling of an $i_{\frac{13}{2}}$ neutron with a low-j neutron partner (from the $p_{\frac{1}{2}}$, $p_{\frac{3}{2}}$ and $f_{\frac{5}{2}}$ orbitals). Negative parity levels in the Os nuclei are populated much less strongly in the $(\alpha,2n\gamma)$ reactions. While 5^- levels corresponding to those in the Pt and Hg nuclei appear to be fairly well established in ^{186}Os, ^{188}Os (and ^{190}Os), it is not yet clear whether the 5^-, 7^-, 9^- ... band sequence extends into the Os nuclei. (auth)

30808 HOW MUCH OF A BUBBLE IS THERE IN ^{184}Hg. Nilsson, S. G. (Los Alamos Scientific Lab., NM); Nix, J. R.; Moeller, P.; Ragnarsson, I. Nucl. Phys., A222: No. 2, 221-234(1974).

Recent suggestions of the existence of bubble-shape nuclei are examined for a few selected nuclei in terms of a Strutinsky shell-correction method type of calculation, based on the folded-Yukawa model. The inner surface is treated by a modified version of the liquid-drop model, allowing for the finite range of the nuclear diffuseness and nucleon–nucleon interaction. It appears safe to conclude that ^{184}Hg is not bubble-like. The observed large $\langle r^2 \rangle$ in this region of Hg nuclei is explained as being associated with a change in distortion. This change is shown to be largely an effect of the introduction of quadrupole pairing. (auth)

30809 BACKBENDING AND ROTATION ALIGNMENT. Stephens, F. S.; Kleinheinz, P.; Sheline, R. K.; Simon, R. S. (Univ. of California, Berkeley). Nucl. Phys., A222: No. 2, 235-251(1974).

The Z and N dependence of backbending in the rare-earth region was examined as given by a model based on the rotation alignment of two $i_{\frac{13}{2}}$ neutrons. The important parameters in this model are the rotational moment of inertia, the position of the Fermi surface, and the deformation (both quadrupole and hexadecapole). To fix these (and other) parameters most reliably, a comparison with the observed rotation alignment of a single $i_{\frac{13}{2}}$ neutron in the adjacent odd-A nuclei is proposed. This comparison is made qualitatively throughout the rare-earth region, and then quantitatively for the two pairs, ^{161}Er, ^{163}Er and ^{171}Hf, ^{173}Hf. Based on these comparisons it seems plausible that all the backbendings so far observed in the rare-earth region could be due to such rotation alignment. (auth)

30810 HIGH SPIN ROTATIONAL STATES IN ^{154}Dy, ^{164}Er, AND ^{162}Yb. Banaschik, M. V. (Univ., Bonn); Guenther, C.; Huebel, H.; Rester, A. C.; Nowicki, G.; Pinajian, J. J. Nucl. Phys.; A222: No. 3, 459-476(1974).

High-spin rotational states in ^{154}Dy, ^{164}Er, and ^{162}Yb were investigated with $(\alpha,4n\gamma)$ and $(\alpha,6n\gamma)$ reactions. The ground-state rotational bands were identified up to spin 14 for ^{154}Dy and ^{162}Yb and spin 16 for ^{164}Er. Anomalous behavior of the moment of inertia was observed in ^{164}Er. (13 figures, 4 tables) (auth)

30811 ANOMALOUS L-SUBSHELL INTERNAL CONVERSION OF SOME HINDERED E1 TRANSITIONS IN ^{171}Tm, ^{175}Lu, AND ^{177}Hf. El-Nesr, M. S. (Atomic Energy Establishment, Cairo); Bashandy, E. Z. Naturforsch.; 28A: No. 12, 1959-1964(Dec 1973).

The L-subshell internal conversion electron ratios of some hindered electric dipole transitions in the odd-mass nuclei ^{171}Tm, ^{175}Lu and ^{177}Hf were measured by means of a high resolution iron-free double focusing beta-ray spectrometer. Large anomalies were observed in the conversion process. The anomalies are interpreted as an experimental evidence for the presence of dynamic effects. The internal conversion penetration parameters were determined. The results obtained are discussed. (auth)

30812 SEARCH FOR ACTINIDES BY SECONDARY REACTIONS IN TUNGSTEN AND GOLD. Ross, E.; Baechmann, K.; Lieser, K. H.; Malek, Z.; Molzahn, D.; Rudolph, J. (Technische Univ., Darmstadt, Ger.). J. Inorg. Nucl. Chem.; 36: No. 2, 251-257(Feb 1974).

Tungsten and gold have been irradiated with 24 GeV and 10.8 GeV protons, respectively, and the possible production of actinide nuclides by secondary reactions has been investigated. The actinide fractions were chemically separated, and α spectra, taken. No α peaks which could definitely be attributed to actinide nuclides could be found. By taking different formation mechanisms into consideration, upper limits for the cross-sections were calculated and compared with the values expected. (auth)

30813 DECAY OF A 1.4 μs STATE IN ^{151}Sm. Cook, W. B.; Waddington, J. C. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 24, 2612-2614(15 Dec 1973).

A pulsed beam of alpha particles was used to excite the 261 keV level in ^{151}Sm through the ^{148}Nd$(\alpha,n\gamma)$ reaction. This level was found to decay with a 1.4 ± 0.1 μs half-life to the 65.83, 91.53, 147.9, and 175.38 keV states. As has been found for heavier odd-neutron nuclei in this region, this isomeric state is probably the $11/2^-[505]$ Nilsson orbital. (auth)

30814 EXPERIMENTAL EVIDENCE FOR NUCLEAR EXCITATION BY ELECTRON TRANSITION IN ^{189}Os. Otozai, K. (Osaka Univ., Toyonaka, Japan); Arakawa, R.; Morita, M. Progr. Theor. Phys. (Kyoto); 50: No. 5, 1771-1773(Nov 1973).

Nuclear excitation by electron transition (NEET) was investigated by electron bombardment of ^{189}Os. According to theory, if the 70.882-keV electron transition occurs (filling a hole in the K orbit), the nuclear state at 69.59 keV may be excited; this state then decays to the 5.7-h isomeric state. The decay curve of radioactivity produced showed the above half-life. Expressions for the relative cross section and the cross section of isomer production were obtained and compared with experimental results. It was concluded that the NEET phenomenon was confirmed in ^{189}Os because the ^{189m}Os activity was found by electron bombardment, the contribution of Coulomb excitation is negligible theoretically, and the relative excitation function is explained by the theory. The NEET cross section is of the order of mb in ^{189}Os. (3 figures) (RWR)

30815 G-FACTOR OF THE FIRST 2^+ STATE IN ^{182}W. Seo, T.; Hayashi, T. (Kyoto Univ., Kumatori, Japan). Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 6: 58-60(Sep 1973).

Radioactive ^{182}Ta was produced by thermal neutron irradiation of natural W for about 1 h. The E2/M1 mixing ratio obtained for the 1121-keV transition was 33 ± 7. The precession measurement was made by using an externally applied magnetic field of kOe. The g factor was found to be 0.217 ± 0.018 for a lifetime of 1.99 ± 0.29 ns. (1 table) (RWR)

30816 NUCLEAR STRUCTURE STUDY IN ^{175}Lu AND ^{182}W BY MEANS OF THE γ–γ DIRECTIONAL CORRELATION METHOD. Quinones, L. M. Lafayette, IN; Purdue Univ. (1973). 112p. University Microfilms Order No. 74-5035.

Thesis (Ph. D.).

The multipole mixing ratios of 4 transitions in ^{175}Lu and 11 transitions in ^{182}W were determined by means of the gamma–gamma directional correlation method. In ^{175}Lu the multipole mixing ratios obtained were all M1 + E2 admixtures, and the results were $\delta(89) = -0.16 \pm 0.07$, $\delta(114) = +0.465 \pm 0.005$, $\delta(319) = -0.152 \pm 0.016$, and $\delta(343) = -0.112 \pm 0.016$. In ^{182}W the triple multipole mixing (E1 + M2 + E3) character of the 1189-keV transition was demonstrated. The deduced values for the mixing ratios of the 1189-keV transition were $\delta(M2/E1) = 0.45 \pm 0.03$ and $\delta(E3/E1) = -0.67 \pm 0.07$. The E2/M1 multipole mixing ratios for other γ transitions (energies in keV) were $\delta(66) = 0.15^{+0.13}_{-0.09}$; $\delta(85) = 0.314^{+0.06}_{-0.05}$; $\delta(114) = 0.313 \pm 0.053$; $0.56 \leq \delta(179) \leq 1.36$; $\delta(1121) = 11.9^{+\infty}_{-3.5}$; $\delta(1231) = -(31.2^{+\infty}_{-13.3})$. The M2/E1 multipole mixing ratios deduced were $\delta(68) = 0.027 \pm 0.014$; $\delta(152) = 0.014 \pm 0.013$; $\delta(156) = -0.13 \pm 0.19$; $\delta(222) = -0.12 \pm 0.18$. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 30739, 30768, 30770, 30772, 30807, 30812, 30823, 30825, and 31044.

30817 (COO-3071-49) POSSIBLE MEASUREMENT OF THE VACUUM POLARIZATION IN HEAVY ION SCATTERING. Rafelski, J.; Klein, A. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1973. 15p. Dep. NTIS $4.00.

A measurement of vacuum polarization effects in nonrelativistic elastic heavy ion scattering is suggested. It is found that in a typical subcoulomb barrier event enough momentum is transferred from the projectile to the target nucleus to make the high q^2 behavior of the photon propagator observable. The elastic cross section is increased in a typical case by 2.5% above the Rutherford value. Only relative measurements are needed. (auth)

30818 LEVELS OF ^{190}Os POPULATED IN THE DECAYS OF 3.3 h ^{190m}Re AND 12d ^{190}Ir AND IN THE ^{189}Os(d,p)^{190}Os REACTION. Yates, S. W. (Purdue Univ., Lafayette, IN); Cunnane, J. C.; Daly, P. J.; Thompson, R.; Sheline, R. K. Nucl. Phys., A222: No. 2, 276-300(1974).

The level structure of ^{190}Os was investigated by the techniques of radioactive decay and neutron transfer reaction spectroscopy. The existence of 3.3 h ^{190m}Re was confirmed; it decays ≈49% by isomeric transitions and ≈51% by β^- decay to levels in ^{190}Os with spins ≥5. In a re-investigation of the 12 d ^{190}Ir decay, a virtually complete decay scheme was established and discrepancies between the I^π values assigned to several ^{190}Os levels by earlier

workers were resolved. The reaction $^{189}Os(d,p)^{190}Os$ was studied and information about the locations of two-quasiparticle states involving the $^3/_2[512]\nu$ orbital and about the microscopic compositions of collective excitations was derived. Various aspects of the ^{190}Os level structure are discussed in the light of the combined radioactivity and transfer reaction results. (auth)

30819 (p,n) REACTION ON HIGH Z ELEMENTS AT 25.8 MeV USING A ROTATING BEAM NEUTRON TIME-OF-FLIGHT SYSTEM. Schery, S. D. Boulder, CO; Univ. of Colorado (1973). 164p. University Microfilms Order No. 73-32,589.

Thesis (Ph.D.).

Angular distributions, reaction Q values, and widths of the analog state were measured for the (p,n) reaction to the isobaric analog state of the targets ^{197}Au, ^{208}Pb, ^{207}Pb, ^{206}Pb, ^{209}Bi, and ^{232}Th at a proton energy of 25.8 MeV. Width measurement gave wider results than previous (p,n) measurements but were in approximate agreement with recent (p,nγ) measurements. Results of distorted-wave Born-approximation calculations indicated that angular distributions were predicted well by both real and complex isospin interactions, although there was less sensitivity to an imaginary surface term than found in previous studies for lower-Z elements. An isospin correction to parameters for (p,p) scattering as determined from (p,n) scattering was used to predict (n,n) scattering in an application of the isospin model due to Lane. Although the isospin correction appeared necessary, it was not sufficient to provide adequate agreement with (n,n) data. A microscopic interpretation of the isospin interaction was used to determine the ratio of the rms radii of the neutron distribution to the proton distribution in ^{208}Pb. The final result for the ratio was $\langle r_n^2\rangle^{1/2}/\langle r_p^2\rangle^{1/2} = 1.072 \pm 0.028$. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 28969, 29525, 30768, 30819, 30834, 30838, 30867, 31044, and 31388.

30820 (ANCR-1129, pp 10-14) MULTILEVEL FITTING OF ^{235}U. Smith, J. R. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

30821 (ANL/NDM-5) DELAYED NEUTRON DATA: REVIEW AND EVALUATION. Cox, S. A. (Argonne National Lab., Ill. (USA)). Apr 1974. Contract W-7405-eng-38. 62p. Dep. NTIS $6.25.

The status of delayed neutron measurements is reviewed. Emphasis is placed on the absolute yield vs the energy of the neutrons causing fission, group yields and periods, and in the delayed neutron spectra. Systematics are discussed; and an evaluated data set, based both on available measurements and on systematics arguments, is suggested for inclusion in ENDF/B-IV. Areas of delayed neutron studies which require additional measurements are outlined. (18 figures, 18 tables) (auth)

30822 (CONF-740104-19) PARTICLE EMISSION BY FISSION. Blewitt, T. H.; Kirk, M. A.; Busch, D. E.; Klank, A. C.; Scott, T. L. (Argonne National Lab., Ill. (USA)). Feb 1974. 9p. Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

The sputtering by fission fragments of Cu, Al, and Nb doped with 0.1 at.% ^{235}U and bombarded with thermal neutrons was investigated. This was primarily a search for micron size particles emitted from the surfaces of the doped sources. Kaminsky et al., have observed large particles (several microns in size) emitted from the surface of samples bombarded by 14 MeV neutrons, with a maximum knock-on energy of 600 keV in Nb. The fission energy deposition of 200 MeV should be more than adequate to yield any observable effects that might be present at 600 keV. The concentration of fission events was 10 times the concentration of knock-ons in the Kaminsky experiments. With scanning electron microscope and energy dispersive x-ray analyses of sputtering collectors both before and after irradiation, no sputtered particles were found larger than one detection limit of 0.1 μ. (auth)

30823 (JINR-P2-7694) CALCULATION OF ELECTRONUCLEAR METHOD FOR NEUTRON PRODUCTION. Barashenkov, V. S.; Toneev, V. D.; Chigrinov, S. E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

A previously described Monte Carlo method used for calculating the multiplication of neutrons produced by high-energy protons on heavy metal targets is modified by using the more precise model of intranuclear cascades, which includes the competition between fission and evaporation of excited residual nuclei. The calculated results for lead and uranium are in good agreement with experimental data. A comparison with the results obtained by other authors is made. The major difference from the earlier conclusions lies in a 10 to 20% decrease both in the energy release in uranium and in the average number of produced neutrons. (4 figures, 2 tables) (auth)

30824 INTERMEDIATE RESONANCES IN THE NEUTRON TOTAL CROSS SECTION OF ^{235}U AT LOW ENERGIES. Part 2. Kitazoe, Y.; Suzuki, H.; Sekiya, T. (Osaka Univ.). Atomkernenergie; 22: No. 3, 214-216(Dec 1973).

The validity of the intermediate resonance model applied in a previous paper with same title is investigated in a more systematic way. The investigation takes into account many resonance levels and ranges over a wider energy region (E 0 ~ 1 MeV). The intermediate resonance model well reproduces both the observed cross section at high energies (E > 60 eV) and an average cross section at lower ones (E < 60 eV), and clarifies a close relation between these two cross sections. (3 figures, 3 tables) (auth)

30825 PHOTOFISSION CROSS SECTIONS OF ^{209}Bi, ^{232}Th, AND ^{238}U AT INTERMEDIATE ENERGIES. de Carvalho, H. G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Martins, J. B.; Tavares, O. A. P.; di Napoli, V.; Terranova, M. L. Notas Fis.; Cent. Brasil. Pesqui. Fis.; 21: No. 5, 67-97(1973).

Photofission cross sections were estimated for ^{209}Bi, ^{232}Th, and ^{238}U, in the energy range from 0.15 GeV up to 2 GeV, by using fissility values computed with the Monte Carlo Method. For the calculation of the fissilities, use was made of some already known results of proton-induced intranuclear cascade calculations, in order to obtain information about mass-number, atomic-number, and excitation-energy distributions of the post-cascade nucleus. The calculation was carried out as a fission–evaporation competition, by using an energy dependence of the ratio of the neutron evaporation width to fission width. The results were compared with experimental data, and the comparison showed that the photofission cross sections are consistent with the photomeson mechanism of nuclear excitation. (6 figures, 3 tables) (auth)

30826 EJECTION OF ATOMS FROM SURFACE OF ELECTRODEPOSITED URANIUM SOURCES BY ALPHA DECAY OR FISSION REACTION. Hashimoto, T. (Kyoto Univ., Kumatori, Japan). Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 6: 10-17 (Sep 1973).

The atoms ejected in vacuo from the surface of some thinly electrodeposited uranium sources, such as uranium-233, enriched (90%) and natural uranium, by alpha decay or fission reaction processes were determined. Aluminium plates were used as collectors. Alpha emitters on the collector and the source were detected by alpha-ray spectrometry and the amount of fission products was determined by gamma-ray spectrometry suing a Ge(Li) detector. The deposition of uranium was also examined by means of fission track method using a muscovite detector. Only daughter nuclides of the concomitant ^{232}U in the ^{233}U sample were found on the collector subjected to alpha decay process, while all nuclides produced from the ^{233}U source by fission reaction process were detected on the collector. The number of uranium atoms knocked out by one fission process was evaluated to be the range of 300 to 1000 under an applied thermal neutron fluence of 8.42×10^{10} cm^{-2}. (auth)

30827 MEASUREMENT OF AVERAGE CROSS SECTION FOR $^{233}U(n,2n)^{232}U$ REACTION. Kobayashi, K.; Hashimoto, T.; Kimura, I. (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 11, 668-673(Nov 1973).

Isotopically pure ^{233}U samples, with only 3×10^{-3} ppm ^{231}U content, were prepared by thermal neutron irradiation of thoria and subsequent chemical processing. The ^{233}U sample thus obtained was reirradiated with a fission neutron spectrum in the core of the Kyoto University Reactor (KUR), and measurements were made of the fission spectrum average cross section for the $^{233}U(n,2n)^{232}U$ reaction. A value of 4.08 ± 0.30 mb was obtained for this cross section, in agreement with the renormalized value of Halperin et al., within the limits of experimental error. In order to assess the energy-dependent cross section from the value of this integral measurement, the $^{233}U(n,2n)$ cross section was calculated assuming a Maxwellian-type fission spectrum and adopting the energy-dependent evaluated cross sections of ENDF/B-III and other authors. The values of the cross section thus determined were found to be about 32 to 91% larger than the measured cross section given above. The result of Pearlstein's calculation of the $^{233}U(n,2n)$ cross section by the statistical model, again assuming the Maxwellian distribution, is smaller than the measured cross section by about 19%. (auth)

30828 SEARCH FOR FISSIONING ISOMERS OF ^{237}U AND ^{236}Np IN THE REGION OF HALF-LIVES OVER 60 μs. Takekoshi, E.; Tsukihashi, Y. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 35: No. 3, 936(Sep 1973).

Pulsed 14.8-MeV neutrons were used to search for fission isomers of ^{237}U and ^{236}Np. The half-lives studied were in the regions from 60 μs to 1 min and of 1 h. Time spectra for the delayed fission events were measured, and the delayed/prompt cross section ratios were obtained. No clear evidence for the fission decay was found; upper limits for the above ratio were estimated to be about 1×10^{-6}. Under 1 h irradiation with dc beams the upper limits deduced were 4×10^{-7} for ^{237}U and 2×10^{-8} for ^{236}Np. It is suggested to the penetration of the outer barrier leading to fission is not favored relative to that of the inner barrier, which would lead to γ decay in the first well. (1 figure) (RWR)

30829 CALCULATION OF NEUTRON INELASTIC SCATTERING CROSS SECTIONS FOR ^{233}Pa AND ^{239}Np. Ohta, M.; Miyamoto, K. (Kyushu Univ., Fukuoka). J. Nucl. Sci. Technol. (Tokyo); 10: No. 9, 583-586(Sep 1973).

The inelastic neutron scattering cross sections for the two nuclides which contribute most to the neutron energy spectrum in an operating fast reactor are evaluated, as well as those for competing processes. The discrete, joint, and continuous regions are separately discussed. The cross sections for the various processes calculated for ^{233}Pa and ^{239}Np are shown for incident energies from 0.01 to 20 MeV. (3 figures, 1 table) (RWR)

30830 MASS DISTRIBUTION IN FISSION OF URANIUM INDUCED BY 170-MeV PROTONS. Haldorsen, L.; Pappas, A. C.; Skarestad, M. (Univ. of Oslo). J. Inorg. Nucl. Chem.; 36: No. 2, 245-249(Feb 1974).

Cumulative and independent fission yields have been determined radiochemically for some long-lived tin and antimony isotopes formed in the reaction U(170 MeV p,f). By use of charge dispersion curves established earlier, chain yields in the mass range $117 \leq A \leq 126$ were calculated. The mass distribution curve has been drawn in the same mass range and proves that a valley occurs in this region. Thus it is confirmed that the mass distribution curve is neither symmetric, nor has it a broad flat maximum. (auth)

Nuclear Theory

Refer also to abstracts 30525, 30549, 30742, 30743, and 31097.

30831 (AERE-R-7373) SOME BACKGROUND AND INTERFERENCE CHARACTERISTICS OF INTERMEDIATE STRUCTURE IN THE FISSION REACTION. Lynn, J. E. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1974. 19p. Dep. NTIS (U. S. Sales Only) $4.00. UK 50 pence.

In the development of a formal theory of the fission reaction, based on the double-humped fission barrier, to explain intermediate structure in fission cross-sections, the possibilities arise of background terms between the intermediate structure resonances and interference terms in these resonances. These matters are discussed in this note; the discussion is based on the formal theory described in previous papers (Lynn, Harwell Report AERE-R5891 (1968); J. Phys. A; 6: 542(1973)). (UK)

30832 (ITF-73-161-P) DEUTERON DIFFRACTION BREAKUP ON NUCLEI WITH DIFFUSE BOUNDARIES. Sitenko, A. G.; Polozov, A. D.; Evlanov, M. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Cross sections are calculated for different diffraction processes when high-energy deuterons interact with nuclei as a function of the magnitude of the smearing of the nuclear boundary. The nonmonotonic dependence of the cross section for deuteron diffraction breakup on the mass number due to the influence of the smearing of the nuclear boundary is shown. (4 figures, 1 table) (auth)

30833 (ORO-4317-27) ACCURACY OF THE DISTORTED WAVE IMPULSE APPROXIMATION (DWIA) FOR BREAKUP REACTIONS IN A THREE-BODY MODEL. Technical Report No. 74-014. Young, S. K.; Redish, E. F. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Mar 1974. 70p. Dep. NTIS $6.50.

The reaction mechanisms of the (p,2p) reaction on ^{4}He at energies of 65 and 100 MeV were studied. The dynamics of the reaction is taken to be that of a three-particle system, the ^{4}He target being viewed as a proton bound to an inert triton. The particles interact via separable potentials chosen to fit bound-state and scattering data of the two-particle subsystems. The protons are treated as identical bosons interacting with each other only in the relative S state, while the proton–triton potential is limited to relative $L \leq 2$. The ^{4}He(p,2p)^{3}H doubly differential cross section can be calculated exactly within this model by solving the Faddeev equations numerically by using the method of deformed contours and Padé Approximants. This can be compared with the DWIA, calculated in this model by summing the appropriate subset of the multiple scattering series. This is done in momentum space, and treats off-shell and finite-range effects of the nucleon–nucleon T matrix as well as recoil effects exactly. It is found that the DWIA is an adequate approximation at 100 MeV, but is almost double the exact result at 65 MeV. Its use in the extraction of spectroscopic information below 100 MeV is therefore suspect. The shapes of the exact, distorted- and plane-wave cross sections agree quite well with each other (and with the experimental shape); only in magnitude do the cross sections differ. (auth)

30834 (ORO-4317-35) ANGULAR MOMENTUM DEPENDENCE OF MOMENTS OF INERTIA AND FISSION BARRIERS OF ^{240}Pu. Technical Report 74-063. Mustafa, M. G.; Kumar, K. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Feb 1974. 10p. Dep. NTIS $4.00.

The method of minimization of the collective potential energy surface with respect to nuclear deformations, energy gaps, and a constraint on $\langle J_x \rangle$ is combined with the two-center shell model and applied to ^{240}Pu. The resulting potential energy surface and, hence, the relative heights of the first and second minima and the first and second barriers are strongly angular momentum dependent. The calculated moments of inertia are compared with experiment. Several experimental tests are suggested. (1 figure, 1 table) (auth)

30835 (TID-26549) ANNUAL REPORT OF THE MICHIGAN STATE UNIVERSITY CYCLOTRON LABORATORY FOR THE PERIOD JULY 1, 1971–JULY 1, 1972. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Nov 1972. 174p. Dep. NTIS $11.75.

Experimental and theoretical research on nuclear reactions and properties is summarized. A list of publications is included. (JFP)

30836 (TLU-21-73) ISOSPIN EFFECTS IN FAST NEUTRON RADIATIVE CAPTURE. Nilsson, L.; Eriksson, J. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Dec 1973. 9p. Dep. NTIS (U. S. Sales Only) $4.00.

The effect of isospin splitting of the giant dipole resonance of the final nucleus on neutron capture cross sections in N = Z nuclei is duscussed. The ^{40}Ca(n,γ) ground state transition is taken as an example. The suggested modification of the semi-direct capture model gives an improved description of the energy dependence of the ^{40}Ca(n,γ_0) cross section. (auth)

30837 THEORY OF STRIPPING REACTIONS LEADING TO RESONANCE STATES. Lovas, R. (Nuclear Research Inst., Debrecen, Hungary). Magy. Fiz. Foly.; 21: No. 6, 519-554 (1973). (In Hungarian).

The DWBA theory of stripping reactions, leading to positive energy states of the final nucleus which preserve their discrete characteristics, is reviewed, together with the various processes of the Lippmann–Schwinger theory of stripping matrix elements intended to eliminate ambiguities. The theoretical and practical techniques and approximations used to describe the decaying end states are outlined and the role of resonance functions (form factors), defined by various models and boundary conditions, is indicated. Proton-transfer reactions leading to isobaric analog resonances and the threshold effect in the (d,p) reaction which appears at the opening of the analog neutron channel receive special attention. It is shown that several theoretical considerations lead to the conclusion that the spectroscopic factor is the ratio of the true width and single-particle width in the model. Specific concrete results are summarized, pointing out critical areas of the individual representations. (Review article, 48 references). (TTT)

30838 STUDY OF REACTIONS INITIATED BY NEUTRONS AND LEADING TO THE GENERATION OF SPONTANEOUSLY FISSIONING NUCLEI FROM THE ISOMERIC STATE. Nagy, T. (Central Research Inst. for Physics, Budapest). Magy. Fiz. Foly.; 21: No. 6, 555-603(1973). (In Hungarian).

The theoretical introduction includes a review of the liquid drop model of nuclear fission, the probability of spontaneous fission, of the fission of the excited nucleus, the shell-structure effect of the fissioning nucleus, interpretation of the double-hump barrier model, and the role of intermediate states. The measuring techniques and equipment are also reviewed, describing the principles of selection, detection of fission products, neutron-beam characteristics, pulsed beam techniques and measurements carried out by means of ionization chambers, spark

counters, time-of-flight techniques and delayed coincidences. Reactions leading to spontaneously fissioning isomers by radiative neutron captures, such as measurement of the excitation functions of the $^{241}Am(n,\gamma)^{242}Am$ and $^{243}Am(n,\gamma)^{244}Am$ reactions are studied, together with experiments aiming at the generation of spontaneously fissioning isomers due to the radiative capture of thermal neutrons. In addition, the use of inelastic neutron scattering and (n,2n) reaction for creating spontaneously fissioning isomers are described, indicating techniques employed for cross section measurements. (Dissertation for the degree of Candidate of Sciences, 84 references). (TTT)

30839 CALCULATION OF CHARGE VIBRATION IN FISSION WITH STRUTINSKY SHELL CORRECTION. Holub, R. (Florida State Univ., Tallahassee); Mustafa, M. G.; Schmitt, H. W. Nucl. Phys., A222: No. 2, 252-268(1974).

The Strutinsky shell correction method was applied to the two spheroid model to study charge vibrations in fission. The investigation is carried out by calculating the potential energy surface with respect to three degrees of freedom: charge vibration from the uniform value and the deformations of the two fragments. The results suggest that the effect of shells at Z = 50 and N = 82 do not cause large deviations from the liquid drop model charge density around mass 132; their effect is much more pronounced in the fragment excitation energy. The results also suggest that the fragment excitation and kinetic energies for a given mass ratio are markedly charge density dependent. Some features inherent to this treatment with respect to characteristic periods of individual degrees of freedom were discussed. (auth)

30840 ANGULAR DEPENDENCE OF A BROAD PERIPHERAL RESONANCE STATE. Fuller, R. C. (Univ., Heidelberg); Avishai, Y. Nucl. Phys., A222: No. 2, 365-376(1974).

The angular dependence of the shape-elastic resonance wave function for a state so broad decay occurs before the ions orbit the interaction region. In the shadow of the interaction region the nonstationary angular dependence is described by a Legendre function for complex angular momentum, P_α (cos θ). In the lit region the same state has the angular dependence $e^{-i\pi\alpha}P_\alpha(-\cos\theta)$. After presenting theoretical arguments which show the necessity of using these different analytic continuations in the shadow and lit regions to states of complex angular momentum by way of illustration of the theoretical argument, results for a strong absorption model introduced several years ago by Austern are shown. (auth)

30841 NEW METHOD FOR DETERMINING K-MATRIX ELEMENTS. Kouri, D. J. (Max-Planck-Institut fuer Stromungsforschung, Goettingen, Ger.); Levin, F. S. Phys. Lett., 48B: No. 3, 203-205(4 Feb 1974).

Formal solutions to the integral equation for the K operator are difficult to obtain because the principal value Green's function does not have a Lippmann–Schwinger iteration. A new Hermitian operator $\tilde{K} = V + V[P/(E - H)]V$ is introduced, and it is shown that its on-shell and half-off-shell partial wave matrix elements are equal to $\cos^2\delta_l$ times those of the usual K operator. From these the fully off-shell values of K can be determined. (auth)

30842 NUCLEAR LEVEL DENSITIES WITH COLLECTIVE ROTATIONS INCLUDED. Doessing, T. (Univ. of Copenhagen); Jensen, A. S. Nucl. Phys.; A222: No. 3, 493-511(1974).

The level density is calculated from the single-particle energies in a Woods–Saxon potential with pairing included in the BCS approximation. The collective rotations are included by addition of a rotational band on top of each of the intrinsic levels. The nuclei investigated have mass numbers in the region $100 \leq A \leq 253$. Calculated and observed level densities are compared at the ground-state deformation and at the neutron separation energy for the nucleus in question. The dependence on the parameters in the model is investigated. In view of the uncertainties in these parameters, the calculated results are believed accurate to within a factor of 3. The rotations contribute typically a factor of 40. They must be included for deformed and not for spherical nuclei. The level density is underestimated systematically by a factor of 4 with fluctuations around the average value by a factor of 3. The nuclei lighter than ^{138}Ba are an exception. Too few levels are obtained in the calculation by a factor of around 100. (4 figures, 3 tables) (auth)

30843 STATISTICAL ANALYSIS OF CORRELATIONS BETWEEN PARTIAL WIDTHS OF DIFFERENT CHANNELS. Baudinet-Robinet, Y. (Univ. Liege, Sart Tilman, Belg.). Nucl. Phys.; A222: No. 3, 525-536(1974).

Some new statistical methods available for the detection of channel–channel correlations are developed. In the two-channel case, a free-distribution test based on the permutation distribution of the correlation coefficient is proposed and compared with other methods in the example $^{29}Si(\gamma,n)$. In the multichannel case, a test based on the calculated distribution of the average correlation coefficient is proposed which avoids the Monte Carlo calculations. This method is applied to the reactions $^{169}Tm(n,\gamma)$ and $^{162}Dy(n,\gamma)$, and is compared with Monte Carlo results. Finally, effects of experimental errors on the correlation coefficient are discussed in the case of the reaction $^{207}Pb(n,\gamma)$. (2 figures) (auth)

30844 NUCLEON OPTICAL POTENTIAL. Rook, J. R. (Univ., Munich). Nucl. Phys.; A222: No. 3, 596-604(1974).

The impulse approximation, the Tabakin internucleon potential, and a Fermi gas model for the nucleus are used to calculate the low-energy nucleon–nucleus optical potential. The real and imaginary parts are calculated simultaneously, but it is found to be an extremely good approximation to calculate them separately, as is usually done. The main features of the real part of the isospin-independent potential are reproduced by the calculation. In addition, the size and shape of the asymmetry term in the real part of the potential are estimated. The size is in agreement with empirical analyses, and the predicted shape may be useful as a guide when fitting data. The calculations for the imaginary part are much less satisfactory. In particular, the large surface peaking of the empirical potentials cannot be reproduced; perhaps this reflects the neglect of collective states. It is found that the observed difference between the imaginary parts for protons and neutrons cannot be explained as a consequence of a reasonable difference between the proton and neutron distributions in nuclei. (2 figures) (auth)

30845 CORIOLIS ANTI-PAIRING TRANSITION IN A SIMPLIFIED SHELL MODEL WITH THE SYMMETRY OF R(5) × R(5). Dasso, C.; Klein, A. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys.; A222: No. 3, 445-458(1974).

A shell model with the symmetry of R(5) and a spectrum interpretable as that of a two-dimensional rotator–vibrator has been studied previously. By considering a direct sum of two such systems and allowing them to exchange angular momentum but not particles, a Mottelson–Valatin phase transition is exhibited under a wide range of values of the parameters characterizing the systems. Solutions are also studied under conditions of particle transfer, which is found to inhibit the phase transition from occurring. All results were obtained by an approximation method (the algebraic-variational method) substantiated in previous works. It is finally indicated how the mechanism of Stephens and Simon—the decoupling from the core of a few particles with individually large angular momenta—can also be incorporated within the framework of the class of models considered. (8 figures) (auth)

30846 SHELL-MODEL CALCULATION FOR MASSES 15, 16, AND 17. Reehal, B. S.; Wildenthal, B. H. (Michigan State Univ., East Lansing). Particles Nucl.; 6: No. 5-6, 137-179(1973).

Shell-model calculations made in the full basis space spanned by the $0p_{\frac{1}{2}}$, $0d_{\frac{5}{2}}$ and $1s_{\frac{1}{2}}$ orbits are presented for nuclei with A = 15, 16 and 17. The single-particle energies and the two-body matrix elements which constitute the effective Hamiltonian employed in this space were determined by a least-squares fit of the shell-model eigenvalues to 153 experimental energy levels in the A = 13 to 22 region. Results for excitation energies, electromagnetic transition rates, and spectroscopic factors for single-nucleon transfer are presented and compared with existing data. It is found that the observed properties of these nuclei can be understood in qualitative and often quantitative detail in terms of the present calculation. (auth)

30847 RELATION BETWEEN LOWEST RESONANCE ENERGIES AND SHAPES OF NUCLEI. Schett, A. (CEN, Saclay, France). Lett. Nuovo Cim.; 9: No. 9, 373-374(2 Mar 1974).

Neutron-induced resonance energies E_0 (z) and the electric quadrupole moments are plotted together as a function of z, which show that the shape of a nucleus and the position of its lowest resonance are related. It is also shown from calculation that the resonance energies are shifted down only for oblate spheroidally shaped nuclei with increasing deformation, which indicates that a deformed nucleus is oblate rather than prolate. (LBS)

30848 MONOPOLE CORE POLARIZATION IN A HARTREE–FOCK BASIS. Ellis, P. J. (Univ. of Minnesota, Minneapolis); Osnes, E. Phys. Lett.; 49B: No. 1, 23-28(18 Mar 1974).

The effect os using self-consistent radial wave functions to calculate the monopole core polarization in the (1s0d) shell was determined. This was found to stabilize the isoscalar monopole phonon in the random-phase approximation and to increase the relative weight of the nuclear surface region in the matrix elements coupling the monopole phonons to the valence particles. In order to account for the isotope shift and Nolen–Schiffer anomaly it is however necessary to use an effective interaction with the proper dependence at the nuclear surface. (auth)

30849 NUCLEAR EXCITATION BY NEUTRAL WEAK CURRENTS. Donnelly, T. W.; Hitlin, D.; Schwartz, M.; Walecka, J. D.; Wiesner, S. J. (Stanford Univ., CA). Phys. Lett.; 49B: No. 1, 8-12(18 Mar 1974).

The use of neutrino excitation of nuclear levels to study weak neutral currents is examined. (auth)

30850 HAUSER-FESHBACH FORMULAS FOR MEDIUM AND STRONG ABSORPTION. Tepel, J. W.; Hofmann, H. M.; Weidenmueller, H. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett.; 49B: No. 1, 1-4(18 Mar 1974).

Using a parameterization of the nuclear S-matrix in terms of the K-matrix, employing a random-matrix model for the latter, and assuming no direct reactions, elastic and inelastic compound nucleus cross sections are numerically calculated. The analysis of these results leads to simple, practically useful formulas of Hauser-Feshbach type. (auth)

30851 INTERPRETATION OF RECENT DATA ON PROTON-NUCLEUS COLLISION AT VERY HIGH ENERGIES. Friedlaender, E. M. (Inst. of Atomic Physics, Bucharest). Lett. Nuovo Cim.; 9: No. 9, 349-353(2 Mar 1974).

An intuitive model of nuclear mesons production is formulated which reproduces recent experimental data on proton-nucleus collisions at very high energies. (LBS)

30852 EVIDENCE FOR NUCLEAR MULTIPLICITY SCALING ABOVE 200 GeV. Friedlaender, E. M.; Marin, A. A. (Inst. of Atomic Physics, Bucharest). Lett. Nuovo Cim.; 9: No. 9, 346-348(2 Mar 1974).

A test was made of the nuclear multiplicity scaling relation at cosmic ray energies by comparing the multiplicity from a sample of primary and secondary ICEF events with the 200 GeV data. It is found that the nuclear multiplicity scaling holds with good approximation at least from 0.1 to 10 TeV and at multiplicities ranging from $\simeq$ 10 to $\simeq$ 20 mesons per proton-nucleus collision. (LBS)

30853 PI-NUCLEUS CHEW-LOW EQUATION FOR FINITE NUCLEI. Ingraham, R. L. (New Mexico State Univ., Las Cruces). Lett. Nuovo Cim.; 9: No. 8, 331-335(23 Feb 1974).

A nuclear Chew-Low equation for finite nuclei is obtained using the LSZ reduction formalism of abstract quantum field theory and correspondingly treating an off-shell amplitude which depends on only one (meson) energy. (LBS)

30854 SPONTANEOUS α-DECAY: A STATISTICAL INTERPRETATION. Bonetti, R. (Univ., Milan); Milazzo-Colli, L. Phys. Lett.; 49B: No. 1, 17-19(18 Mar 1974).

α-radioactivity is examined from the point of view of a statistical approach. The radioactive nucleus before decay is seen like a compound nucleus of a reaction before particle emission, having an α-particle separated in single particle states. Transmission factors are calculated using optical model parameters. An α-preformation coefficient is introduced, whose values are found between 1 and 0.01. (auth)

30855 PION CONDENSATION. Bertsch, G. F. (Michigan State Univ., East Lansing); Johnson, M. B. Phys. Lett.; 48B: No. 5, 397-398(4 Mar 1974).

A criterion for pion condensation in nucleon matter can be concisely formulated when the pion Green function is given by the sum of poles, and is simply that two poles on the opposite side of the real axis come together. This criterion gives identical instability conditions as found by Sawyer using a different method. (auth)

30856 GENERALIZED DISTORTED-WAVE APPROXIMATION FOR NUCLEAR REARRANGEMENT REACTIONS. Cattapan, G.; Vanzani, V. (Univ., Padua). Nuovo Cim.; 20A: No. 3, 521-534 (1 Apr 1974).

Starting from an exact three-body theory for the nuclear rearrangement reaction $a + (b + c) \rightarrow b + (a + c)$, a generalized distorted-wave approximation is studied in the momentum-space representation. Using suitable kinematic transformations this representation in a form coinciding with the one obtained by means of the Feynman-diagram summation method. The generalized potential responsible for the transition will be written in a compact form involving the resolvent operator for the a-b subsystem. (auth)

30857 NOLEN-SCHIFFER ANOMALY AND THE CONSERVED VECTOR CURRENT. Wilkinson, D. H. (Oxford Univ.). Phys. Lett.; 48B: No. 5, 407-409(4 Mar 1974).

It is shown that Noble's treatment of the Nolen-Schiffer anomaly in terms of the polarization of the core by valence nucleons permits the demonstration that admixing of the isovector breathing mode by Coulomb forces has a negligible effect of the ft-values of super-allowed Fermi transitions. (auth)

30858 IS THERE A GIANT (3,3) RESONANCE IN NUCLEI. Dillig, M.; Huber, M. G. (Univ., Erlangen, Ger.). Phys. Lett.; 48B: No. 5, 417-419(4 Mar 1974).

The influence of the structure of a nucleus on the nuclear (3,3) resonance is discussed in the framework of a special kind of a particle hole model where the elementary excitation mode is assumed to be the transition of a bound nucleon into a (bound) Δ. The residual interaction between a nucleon and a Δ leads to a mixing of different particle-hole excitations and hence, collective effects are expected to show up, resulting for example in a shift of the main peak of the excitation spectrum; furthermore — due to quenching — a fine structure in the spectrum could be visible, — Recent experimental data on the ^{4}He(γ,pπ^-) reaction can possibly be interpreted in the present model with an attractive NΔ residual interaction. (auth)

30859 DIFFERENCE IN THE ELECTRONIC AND FISSION DECAY MODES FOR MUONIC ATOMS. Bloom, S. D. (Univ. of California, Livermore). Phys. Lett.; 48B: No. 5, 420-422(4 Mar 1974).

A simple model is presented which predicts a difference in the electronic and fission decays of ground-state muonic heavy atoms. It is interpretable in terms of the relative population of two nuclear states: the isomeric fission state and the ground state. The application of the model to ^{238}U indicates there could be a significant population of the isomeric state at the end of the muonic atomic cascade. (auth)

30860 (^{6}Li, ^{6}He) SPIN-ISOSPIN-FLIP REACTION. Gaarde, C. (Univ. of Copenhagen); Kammuri, T.; Osterfeld, F. Nucl. Phys.; A222: No. 3, 579-595(1974).

A formulation of the (^{6}Li, ^{6}He) spin-isospin-flip scattering problem is presented. The method is applicable to quasi-elastic collisions between ^{6}Li described in pure LS coupling scheme and any target nucleus which can be described in a shell-model or an adiabatic deformed-nucleus-model picture. The effective interaction responsible for the (^{6}Li, ^{6}He) reaction involves an integration of the $(\sigma_1 \cdot \sigma_2)$ $(\tau_1 \cdot \tau_2)$ component of the central part of the $(\tau_1 \cdot \tau_2)$ tensor part of the nucleon-nucleon interaction over the internal wave function of the projectile. The ^{48}Ca(^{6}Li, ^{6}He)^{48}Sc reaction populating the $(\pi f_{\frac{7}{2}} \nu f_{\frac{7}{2}}^{-1})$ multiplet in ^{48}Sc is analyzed. It is found that the tensor force make some contribution to the transitions to high-spin states. (9 figures, 3 tables) (auth)

30861 GAMOV STATES. Gyarmati, B. (Nuclear Research Inst., Debrecen, Hungary). Magy. Fiz. Foly.; 21: No. 5, 465-500 (1973). (In Hungarian).

The Gamov function is defined and the properties of the S matrix are described together with various properties of Gamov functions, such as orthogonality. The author's own studies include derivation of the general form suitable for the numerical approximation of the Gamov function's norm and application of these, functions to describe isobaric analog resonances, giving numerical examples. The most widely used resonance-state wave functions are compared within the framework of a quadrilateral model. (21 references). (TTT)

30862 NUCLEAR FORCE AND A MAGNETIC MONOPOLE MODEL OF HADRONS. Sawada, T. (Tokyo Univ. of Education). Nucl. Phys.; B71: No. 1, 82-92(1974).

The two-pion exchange potential of the nuclear force is constructed from the phase shifts of the low energy πN and $\pi\pi$ scattering. The large difference between the potentials thus constructed from the phenomenological potentials of Hamada-Johnston and of Byran is pointed out. It is found that this difference has the form of the attractive Van der Waals potential plus an inner repulsive core. The existence of the Van der Waals force is discussed in connection with the magnetic monopole model of hadrons. (auth)

30863 APPLICABILITY OF THE GENERATOR COORDINATE METHOD TO COMPOSITE-PARTICLE SCATTERING. Tanabe, F. (Kyoto Univ.); Tohsaki, A.; Tamagaki, R. Progr. Theor. Phys. (Kyoto); 50: No. 5, 1774-1776(Nov 1973).

A phase-shift analysis of $\alpha-\alpha$ scattering is performed up to 60 MeV (c.m.). Phase shifts with the Coulomb effect calculated by use of the generator coordinate method (GCM) are shown, along with those found by using the resonating-group method (RGM). The good agreement between the results suggests the possibility that the GCM can be used as a substitute for the RGM in scattering problems over a wide energy region. Agreement with experimental values is fairly good: it is expected that even better agreement can be obtained through use of a more realistic nuclear force with the correct range. (1 figure) (RWR)

30864 MODIFIED EULER EQUATIONS FOR THE CORRELATION FUNCTION IN THE CASE OF IMPURE NUCLEAR MATTER AND OTHER MANY-PARTICLE SYSTEMS. Grypeos, M. E. (Univ. of Thessaloniki, Greece). Lett. Nuovo Cim.; 9: No. 13, 519-524(30 Mar 1974).

The problem of the determination of the Jastrow correlation function used in the variational approach to many-particle systems is treated. Modified Euler equations are given, and the results obtained are discussed. (JFP)

30865 NUCLEAR FORCES IN MOMENTUM SPACE WITH ONE-BOSON-EXCHANGE MODEL. Hoshizaki, N.; Kadota, T. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 4, 1312-1333 (Oct 1973).

A one-boson-exchange potential (OBEP) with six kinds of bosons (π, σ, ρ, ω, η, and δ) is treated in momentum space to describe the nucleon–nucleon interaction below 400 MeV. Integral equations containing OBEP with full nonstatic effects are solved numerically. All the experimental phase shifts for the states with $L \geq 1$ are well reproduced by adjusting only four parameters: the ω–nucleon coupling constant, $g_\omega^2/4\pi$; the δ–nucleon coupling constant, $g_\delta^2/4\pi$; the σ–nucleon coupling constant, $g_\sigma^2/4\pi$; and the mass of the σ meson, m_η. The contribution from η-meson exchange is shown to be small. S-state phase shifts are also reproduced if the contribution from higher momentum part is cut off. A list of all the matrix elements of the nonstatic OBEP is given. (auth)

30866 ISOSCALAR TRANSITION DENSITIES OF ISOVECTOR EXCITATIONS. Goulard, B. (Univ. of Montreal); Deal, T.J.; Fallieros, S. Can. J. Phys.; 52: No. 1, 89-90(1 Jan 1974).

An energy-weighted sum rule is written down containing both isoscalar and isovector transition densities. As an application, a previously obtained expression for the isoscalar transition density of a dipole state is rederived. (auth)

30867 STATISTICAL THEORY OF SHAPE ISOMERS. Aframe, A. M. Troy, NY; Rensselaer Polytechnic Inst. (1973). 181p. University Microfilms Order No. 74-5131.

Thesis (Ph.D.)

At present, the double-humped fission barrier model provides the only explanation for the existence of shape isomers. A statistical, spin-dependent method based on this model is developed for the calculation of isomer and isomer-to-prompt ratios. A study of these quantities can yield important information about fission barrier, inertial mass, and level density parameters. Calculations were performed for a variety of reactions which proceed via the formation of a compound nucleus. In particular, (n,γ), (α,2n), (α,3n), (d,2n) and (n,2n) reactions were studied. Finally, the method was applied to the heavy-ion-induced reaction $^{238}U(^{11}B,\alpha 3n)^{242}Am$, and isomer ratios were calculated for projectile energies ranging from 50 to 75 MeV. Good agreement between experiment and theory was obtained in most cases without resort to parameter fitting. These results indicate that the double-humped fission barrier model can be combined with the statistical model to form a unified, consistent theory for the calculation of isomer ratios and related quantities. (Diss. Abstr. Int., B)

30868 THEORY OF QUASI-DEUTERON EMISSION IN PHOTONUCLEAR REACTIONS. Elsaesser, W. R. Charlottesville, VA; Univ. of Virginia (1973). 104p. University Microfilms Order No. 73-31,126.

Thesis (Ph.D.).

The quasi-deuteron process is studied by using, for the photon interaction operator, the conventional charge coupling to the electromagnetic field. The interaction of the photon with the magnetic moments of the nucleons is neglected. Differential cross sections are obtained for various energies and opening angles of the emitted np pair. The radial wave functions describing the outgoing pair are taken to be the solutions of the Schrödinger equation in a hard-core Hamada–Johnston potential. Differential cross sections are also computed and compared with the foregoing calculations, for various kinematic cases, when asymptotic functions are used to describe the radial motion of the emitted pair. Differential cross sections for 100-MeV photons are found to be rather insensitive to initial correlations. In addition, the effect of the residual-nucleus nucleon interaction is estimated by considering its influence on the effective energy at which the two-nucleon scattering takes place. Results indicate that this method of accounting for the effect of the residual nucleus is unsatisfactory. Finally, comparisons with experiment are made for photon energies in the 100 to 125 MeV and the 210 to 260 MeV ranges. Theoretical results are found to be in reasonable agreement with experiment in the former energy range, but are over two orders of magnitude lower than experiment in the latter range. This large discrepancy at high energies lends support to the contention that mesic enhancement of the nuclear photoeffect cross section is especially important above the pion threshold. (Diss. Abstr. Int., B)

30869 WIDTH FLUCTUATION CORRECTIONS TO COMPOUND NUCLEAR REACTIONS. Chen, M. T. Provo, UT; Brigham Young Univ. (1973). 140p. University Microfilms Order No. 73-31,201.

Thesis (Ph.D.).

Within the framework of the Hauser–Feshbach–Moldauer formalism the level width fluctuation correction, S, is dependent upon the statistical distributions of the particle reduced widths. The magnitude of this correction was examined both as a function of the number of competing channels, C, and as a function of the degrees of freedom, ν, of the chi-square distributions for different l-valued particles. The particle excitation functions incorporating the correction factor S with various possible degrees of freedom are evaluated through a computer code "JANEY." Sample calculations of ^{56}Fe and ^{27}Al are computed up to 7.5 MeV. When several competing channels are present, S is approximately equal to $1\text{-}2/\nu C$. Previously reported anomalous behavior of S in the energy region several MeV above reaction thresholds is resolved. (Diss. Abstr. Int., B)

30870 MICROSCOPIC DESCRIPTION OF ROTATIONAL MOTION. Yamamura, M. (Kyoto Univ.). Nishiyama, S. Progr. Theor. Phys. (Kyoto); 50: No. 1, 137-146(Jul 1973).

The theoretical framework of the method developed by Gross and one of the present authors (M. Y.) for the description of rotational motion is shown to be completely equivalent to that of Bohr's rotational model for the case of the ground-state rotational band of deformed even nuclei. For simplicity, we restrict ourselves to the case of a single-j shell system of even identical particles with a quadrupole interaction. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

30871 (CONF-720804-P2) FIFTH EUROPEAN CONFERENCE ON CONTROLLED FUSION AND PLASMA PHYSICS, GRENOBLE, FRANCE, AUGUST 21–25, 1972. Volume II. Invited Papers and Supplementary Papers. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1972. 255p.

Separate abstracts were prepared for 22 of the included papers. Twenty-five of the remaining papers have appeared previously in NSA. (MOW)

For abstracts of individual papers see: 30873–30880, 30915, 30924–30926, 30935, 30938–30940, and 30959–30966.

Confinement and Heating

Refer also to abstracts 30937 and 30995.

30872 (AD-767599-4-GA) TWO-DIMENSIONAL EFFECTS IN LASER–SOLID SIMULATION STUDIES. Final Report, 1 June 1971–31 July 1973. Daiber, J. W.; Thompson, H. M.; Rehm, R. G. (Calspan Corp., Buffalo, N. Y. (USA)). Aug 1973. Contract F44620-71-C-0102. 35p. (AFOSR-TR-73-1700). NTIS $3.75.

The objective of this program is to study the two-dimensional wave motions induced in a target by high-power laser radiation. For these studies the target is an axisymmetric, supersonic free-jet of hydrogen gas which is laser irradiated on axis. The transparency of the target permits luminosity and schlieren streak photography of the forward-facting waves that propagate into the high-pressure plenum. Measurements of the axial and lateral luminous plasma growth during the laser pulse and of the axial shock wave growth after the pulse have been obtained for hydrogen gas targets over a range of plenum pressures and laser powers. It has been found that the axial luminous-front growth can be predicted by a deflagration model; in this model the velocity scales with the parameter absorbed power divided by gas reservoir pressure to the one-third power. The shock-wave velocity along the axis of symmetry also appears to scale with this parameter. An explanation for this latter result has been proposed. (auth)

30873 (CONF-720804-P2, pp 59-70) TOROIDAL CONFINEMENT IN SCREW PINCHES WITH NONCIRCULAR PLASMA CROSS-SECTION. Zwicker, H.; Wilhelm, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

Toroidal screw pinches with elliptical or bar-shaped plasma cross section can be operated below the Kruskal–Shafranov limit also at high-β values. In this case piston heating can be used. Experimental results are given. They show a belt-pinch plasma which is grossly stable for about 100 μs. The life-time is obviously limited by diffusion. (auth)

30874 (CONF-720804-P2, pp 71-82) CONFINEMENT STUDIES IN 2XII. Coensgen, F. H.; Cummins, W. F.; Molvik, A. W.; Nexsen, W. E.; Simonen, T. C. (Univ. of California, Livermore). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

The containment of deuterium plasmas in a magnetic mirror well was investigated for mean plasma ion energies in the range from 1 to 10 keV. Evidence indicates that detectable plasma turbulence in this experiment arises primarily from instabilities driven by the presence of two or more maxima in the ion velocity function. Plasmas with no detectable turbulence were formed with mean energies in the range from 1.2 to 2.7 keV. The ion velocity functions of all quiescent plasmas have a single maxima. For these plasmas neither the magnitude nor the density dependence of the loss rate was noticeably different for runs which were theoretically stable for the Dory–Guest–Harris mode and those that were unstable. In both cases n_τ at high densities was below that calculated for collisional losses by a factor of two to three and decreased as the density fell. Although losses induced by other instabilities (e.g., drift-cyclotron, loss-cone mode) cannot be ruled out, the high density data from quiescent decays appear to be in agreement with the Baldwin-Callen theory of "collective scattering". (auth)

30875 (CONF-720804-P2, pp 83-92) PLASMA DIFFUSION IN TWO AND THREE DIMENSIONS. Taylor, J. B. (Culham Lab., Abingdon, Eng.). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

Investigation of diffusion in two dimensional plasmas has shown that at high magnetic fields it is always proportional to 1/B. When this investigation is extended to three-dimensions a 2D-like contribution to diffusion is found which dominates the classical, $(1/B^2)$ diffusion at high fields. This 2-D like contribution diminishes slowly with the size of the system and is susceptible to shear. Its importance in experimental plasmas is discussed. (auth)

30876 (CONF-720804-P2, pp 119-134) PROPERTIES OF SOME TYPES OF PLASMA SHOCK WAVES. Hintz, E. (Kernforschungsanlage, Juelich, Ger.). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

Shock relations for strong MHD-shock waves are summarized. Generation of such shocks in the laboratory and their utilization for plasma heating is discussed. Some results of experimental studies on plasma heating by fast magnetic compression are reported. The present status of theory with regard to the steady state structure of plasma shock waves is described for two special cases, i.e., collision-dominated shocks in a magnetic-field-free plasma and shocks in a plasma with $\beta \ll 1$ and $\omega_{ce}\,\tau_{ei} \gg 1$. Experimental results on shock structures are compared with theory. The significance of these studies for the understanding of dissipative processes in thermal and nonthermal plasmas is examined. (auth)

30877 (CONF-720804-P2, pp 135-146) CONTAINMENT AND rf HEATING STUDIES IN THE PROTO-CLEO STELLARATOR. Lees, D. J.; Millar, W.; Bolton, R. A. E.; Cattanei, G.; Plinate, P. L. (Culham Lab., Abingdon, Eng.). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

Experiments are described, using the $l = 2$ and $l = 3$ helical windings, in which the containment of plasma injected into the two systems is compared, both with each other and with the predictions of neo-classical theory. Transit time magnetic pumping (TTMP) was attempted on the $l = 2$ system. The chief effect is a large reduction in confinement time, although some heating is observed. Experimental results concerning the increased plasma loss rate are given. (auth)

30878 (CONF-720804-P2, pp 147-156) CERTAIN RESULTS OF STELLARATOR EXPERIMENTS IN THE USSR. Kovrizhnikh, L. M. (Lebedev Inst. of Physics, Moscow). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

The report presents a survey of stellarator experiments which have been carried out in the Soviet Union after the 1971 Madison Conference. The data on the particle confinement are briefly analyzed. (auth)

30879 (CONF-720804-P2, pp 157-169) NUMERICAL MODELS FOR PLASMA EVOLUTION IN TOKAMAK DEVICES. Mercier, C.; Soubbaramayer. (CEA, Fontenay-aux-Roses, France). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

A fluid description is given in order to simulate the evolution of a plasma in a tokamak. The effect of neutral particles in the plasma is considered. The numerical model is applied to several plasma states. (MOW)

30880 (CONF-720804-P2, pp 240) PLASMA CONFINEMENT EXPERIMENT IN HELIOTRON D. Iiyoshi, A.; Morimoto, S.; Konoshima, S.; Yoshioka, S.; Sato, M.; Otake, I.; Uo, K. (Kyoto Univ.). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

Experimental results are briefly described for Joule heating and rf heating of the Heliotron D plasma. (MOW)

30881 (CONF-721111-, pp 15-26) ALPHA-PARTICLE HEATING OF MIRROR PLASMA. Galbraith, D. L.; Kammash, T. (Univ. of Michigan, Ann Arbor). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

A binary collision theory modified to account for both classical and quantum descriptions of scattering in the appropriate velocity ranges is used to calculate the alpha-particle heating of a mirror-confined plasma. An approximate loss cone distribution for the ions was simulated numerically by the sum of five Maxwellian distributions with appropriate temperatures. It is shown that, for the mirror distributions studied, the alpha–ion energy exchange may be

represented quite well by calculations using an equivalent Maxwellian, which has the same average energy as the mirror distribution. (auth)

30882 (CONF-721111-, pp 146-159) MODEL TOKAMAK REACTORS LIMITED BY ANOMALOUS DIFFUSION AND SYNCHROTRON RADIATION. Horton, W. Jr.; Kammash, T. (Univ. of Texas, Austin). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

A continuous D–T Tokamak reactor model based on time-dependent solutions of the dynamic equations for the plasma variables in the D, T, α and e system is proposed. In the calculations the plasma is heated by alpha-particle production only, and both bremsstrahlung- and synchrotron-radiation losses are taken into account. The dependence of the reactor states on a wide range of variation in the confinement law is studied. Anomalous diffusion increases the fuel-injection requirements but has the advantage over neoclassical confinement in maintaining substantially lower plasma beta for given reactor parameters and power. (auth)

30883 (CONF-721111-, pp 226-248) SELF-CONSISTENT ENERGY-BALANCE STUDIES FOR CTR TOKAMAK PLASMAS. Conn, R. W.; McAlees, D. G.; Emmert, G. A. (Univ. of Wisconsin, Madison). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

The equations required to study the dependence of the steady-state operating conditions in a Tokamak-like CTR plasma on various system parameters are solved. Particle diffusion is explicitly represented by neoclassical theory, and β_p, the ratio of plasma pressure to poloidal magnetic-field pressure, is limited to a maximum value of $A^{\frac{1}{2}}$, where A is the aspect ratio. The particle- and energy-balance equations are solved self-consistently with the confinement-time equation and the constraint equation on plasma pressure. The dependence of the plasma operating parameters on enhanced bremsstrahlung radiation losses and enhanced diffusional losses is studied. A viable Tokamak-like CTR plasma is suggested consistent with parametric study. (auth)

30884 (CONF-721111, pp 322-346) D–D PLASMA FUSION POWER-BALANCE CALCULATIONS. Chu, T. C.; Miley, G. H. (Univ. of Illinois, Urbana). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Energy-balance calculations for a D–D fusion plasma are solved to obtain $n\tau$ requirements, electron–ion temperature ratios, and the output power split between radiation and charged particles. A pure deuterium fuel is considered, but the tritium and ^{3}He products are assumed to have a containment time equal to that of the fuel and thus add to the fusion power. A minimum $n\tau$ for energy balance of about 3×10^{21} sec/m^3 is found for $T_i \approx 85$ keV for a self-heated plasma with reasonable reabsorption of cyclotron radiation. This is reduced to less than 10^{21} sec/m^3 with energetic ion injection. Simultaneous $n\tau$ requirements imposed by plant efficiencies and recycle ratio are examined along with values expected for confinement by several typical reactors. The potential for neutral injection mirror or staged theta-pinch operation on D–D appears to be marginal, whereas the Tokamak seems to offer suitable conditions provided stable operation can be achieved in the 40- to 60-keV range. Of the energy initially given to charged fusion products, about 22% is lost by radiation at the minimum $n\tau$ point for the self-heated plasma. This percentage can be maintained even at ion temperatures of several hundred kiloelectron volts if high-energy ion injection is employed to maintain small T_e/T_i ratios. (auth)

30885 (CONF-721111-, pp 347-357) POWER-BALANCE PARAMETERS Q AND ϵ AS MEASURES OF PERFORMANCE FOR FUSION POWER REACTORS. Persiani, P. J.; Lipinski, W. C.; Hatch, A. J. (Argonne National Lab., IL). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Power-producing fusion-reactor systems may require a complex of plasma-producing subsystems (containment, heating, and injection) and of energy-conversion subsystems (thermal and direct). So that there can be a basis for comparing these reactor power systems, generalized definitions based on power balance are proposed for the two important power-balance parameters: Q, ratio of output to input power, and ϵ, fractional circulating power. The values of Q and ϵ determined from the proposed generalized definitions are compared with values in the literature based on different definitions. (auth)

30886 (CONF-721111-, pp 842-852) BREAK-EVEN CRITERIA FOR A PULSED D–T REACTOR. Keller, K. F.; Dolan, T. J. (Univ. of Missouri, Rolla). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

The assumption of constant, uniform ion density and temperature in the calculation of $n_0\tau$, the Lawson criterion for fusion plasma containment, leads to values of $n_0\tau$ that are unrealistically low. A more accurate value of $n_0\tau$ is obtained by considering exponentially decaying, nonuniform ion densities and temperatures. Values of $n_0\tau$ are given for various initial ion temperatures and spatial distributions of density and temperature, assumed to be exponentially decaying. At low temperatures (≈10 keV), values of $n_0\tau$ are approximately an order of magnitude higher than in the case of constant, uniform density and temperature. The values of $n_0\tau$ are strongly dependent upon initial ion temperature at low temperatures, and the minimum $n_0\tau$ is not reached until an ion temperature of 40 to 50 keV is attained. (auth)

30887 (CONF-730315-, pp vp. Sect A3) PLASMA EXPERIMENTS ON l = 1.0 HELICAL EQUILIBRIA IN THE SCYLLAC TOROIDAL SECTOR. Ellis, W. R.; Jahoda, F. C.; Quinn, W. E.; Sawyer, G. A.; Siemon, R. E. (Los Alamos Scientific Lab., NM). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Experiments are reported on a sector comprising one third of the 4.8-m diameter Scyllac torus. The toroidal force and outward plasma drift are compensated by an interference force produced by a combination of l = 1 helical and l = 0 bumpy fields. The toroidal equilibrium is observed, followed by an m = 1 (sideward) motion of the plasma column, which is nearly the same all along the torus, independent of the l = 0 periodicity, with plasma containment times as large as 11 μsec. (auth)

30888 (CONF-730315-, pp vp. Sect A8) TIME DEPENDENT BELT PINCH DIFFUSION. Bateman, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The Belt Pinch at Garching may be thought of as a shock heated Tokamak with highly elongated cross section. The present plasma is typically 40 cm high, several cm thick and 23 cm major radius. The plasma appears to be grossly stable, with its lifetime limited by diffusion and energy loss. A model for the time history of diffusion in the later stages of the discharge (after the adiabatic compression), assuming fixed temperature, is summarized. (auth)

30889 (CONF-730315-, pp vp. Sect B1) ANALYSIS OF THE ELECTRON ENERGY DISTRIBUTION FUNCTION IN THE TM 3 TOKAMAK. Abramov, V. A.; Alikaev, V. V.; Arsenin, V. Ya.; Bobrovskii, G. A.; Kazanyan, G. P.; Kogan, V. I.; Razumova, K. A. (Inst. of Atomic Energy, Moscow). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The electron distribution function is constructed by the method of regularization. The function seems to have a positive derivative near the energy of 100 keV. (auth)

30890 (CONF-730315-, pp vp. Sect. B6) TEXAS TOKAMAK EXPERIMENT. Drummond, W. E.; Nielsen, P.; Phillips, P.; Medley, S.; Jancarik, J.; Bengston, R. (Univ. of Texas, Austin). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The concept of the Texas Tokamak Experiment is to combine strong turbulent heating with the Tokamak magnetic confinement geometry. Strong pulsed turbulent heating has produced plasma temperatures on the order of 10 keV in small toroidal experiments. The basic concept of strong turbulent heating is to suddenly apply a strong electric field, i.e., hundreds of volts/cm around a toroidal device. This generates strong plasma turbulence giving a plasma resistance several orders of magnitude larger than the classical resistance at high temperatures. The large resistance leads to rapid current penetration and plasma heating. (auth)

30891 (CONF-730315-, pp vp. Sect. B7) EXPERIMENT OF ANOMALOUS HEATING AND CONFINEMENT OF PLASMA IN A TOKAMAK-LIKE MAGNETIC CONFIGURATION (T.T.F.). Martone, M. [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Fast current diffusion ($\tau < 1$ μsec) in a preionized H_2 plasma (4.5 mtorr) with simultaneous increase of plasma energy ($\beta_p = 0.4$) was observed in a tokamak-like experiment ($R - 30$ cm, $a = 4$ cm, $B_T = 6.2$ kG, $I_P - 7.6$ kA). After the current diffusion (heating) phase, the plasma current, decoupled from the energy source, decays in a time which depends on the toroidal magnetic field strength. (auth)

30892 (CONF-730315-, pp vp. Sect. B8) HYDROMAGNETIC WAVE HEATING OF TOKAMAK PLASMAS. Perkins, F. W.; Chance, M.; Kindel, J. M. (Princeton Univ., NJ). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The heating of a tokamak plasma by radiofrequency methods enjoys several advantages over its principal competitor, neutral-beam heating. (1) Energy penetration: As tokamaks become larger, high neutral beam energies (100's keV) are required to penetrate to the center while wave energy penetrates readily. (2) Heating rate: Because wave damping decrements considerably exceed the slowing down rate for energetic ions; the non-thermal energy densities associated with wave heating are considerably below the energetic ion energy density (for the same power input) and thus less likely to induce low-frequency instabilities. (3) Power sources: Megawatt rf sources are available while neutral beams are presently limited to ~100 kw. (4) Energy confinement: Wave heating usually produces a mild increase in the perpendicular ion temperature and/or a high-energy tail in the electrons. Some theoretical relations for heating in the ion-cyclotron frequency range are given. (MOW)

30893 (CONF-730315-, pp vp. Sect. B9-I) PRINCETON TOKAMAK EXPERIMENTS. Furth, H. P. (Princeton Univ., NJ). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Brief discussions are given for the following areas of research: (1) Ohmic heating, (2) compressional heating, (3) the high-density limit, and (4) the disruptive instability. (MOW)

30894 (CONF-730315-, pp vp. Sect. B19) MAGNETIC COMPRESSION OF TOROIDAL PLASMA IN TUMAN-2 DEVICE. Beresovskii, E. L.; Gusev, V. K.; Kaganskii, M. G. (Ioffe Inst. of Physics and Tech., Leningrad). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Experiments are described on plasma column compression at magnetic fields increasing from 3 to 12 kG for 120 μsec. Appreciable decrease in plasma oscillations is observed at the compression. A 3.5-fold rise in plasma concentration and a 2.5-fold increase in electron temperature were obtained. (auth)

30895 (CONF-730315-, pp vp. Sect. B25) X-RAY SPECTRA IN THE ST-TOKAMAK. von Goeler, S.; Stodiek, W.; Sauthoff, N.; Selberg, H. (Princeton Univ., NJ). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The high energy electron component produced by electron runaway in the toroidal electric field of the ST-Tokamak has been investigated by Bremsstrahlung measurements. A quantitative comparison is made of the concentration of the high energy component with a model in which continuous production of runaway electrons in the center of the discharge is balanced in steady state by continuous loss. (auth)

30896 (CONF-730315-, pp vp. Sect. C2-I) INTERNAL RING EXPERIMENTS AT PRINCETON PLASMA PHYSICS LABORATORY. Yoshikawa, S. (Princeton Plasma Physics Lab., NJ). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

A cross-sectional view of the FM-1 spherator is shown. The experimental procedure for studying confinement is outlined. Confinement time data are described for various electron temperatures. (MOW)

30897 (CONF-730315-, pp vp. Sect. C3) NEUTRAL INJECTION PLASMA IN THE CULHAM LEVITRON. Freeman, R.; Riviere, A. C.; Sweetman, D. R. (Culham Lab., Abingdon, Eng.). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The injection and trapping of a 5-keV neutral atom beam in a toroidal levitron are described. There appears to be no anomalous loss of these injected atoms at least for times of the order of 4 msec. The resulting cold plasma produced by their ionization of the gas has a lifetime of several hundred milliseconds. (MOW)

30898 (CONF-730315-, pp vp. Sect. C4) CLASSICAL DIFFUSION DUE TO THERMAL EQUILIBRIUM FLUCTUATIONS IN THE dc OCTOPOLE. Tamano, T.; Prater, R.; Ohkawa, T. (Gulf General Atomic Co., San Diego, CA). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

"Classical" diffusion due to thermal equilibrium fluctuations has been experimentally observed in the dc octopole. Measurements of the magnitude and of the dependences of this diffusion coefficient on plasma parameters are presented. "Classical" diffusion due to thermal equilibrium fluctuations is a topic of recent theoretical interest with respect to plasma confinement. This diffusion can exceed classical diffusion due to binary electron–ion collisions when the plasma dielectric constant is small. This regime is investigated in the dc octopole. (auth)

30899 (CONF-730315-, pp vp. Sect. C6) PLASMA HEATING AND CONFINEMENT IN THE LIVERMORE SUPERCONDUCTING LEVITRON. Hartman, C. W.; Anderson, O. A.; Birdsall, D. H.; Hooper, E. B. Jr.; Munger, R. H. (Univ. of California, Livermore). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Stable confinement of approximately isotropic hot-electron plasma is observed for $\beta \lesssim 0.1$ and $\beta_\phi = \beta B^2/B_\phi^2 \lesssim 10$. Confinement at large β_ϕ without anomalous loss is found to result from a cold-plasma background with $n_{ec}/n_{eh} \simeq 10-10^2$. Heating of dense plasma ($n_{ed} \simeq 10^{11}-5\times10^{12}$, $T_{ed} \simeq 10-20$ eV) occurs by thermalization with the hot-electron plasma at a collision-determined rate without significant anomalous loss of hot electrons. (auth)

30900 (CONF-730315-, pp vp. Sect. D3-I) WENDELSTEIN EXPERIMENTS. Grieger, G. (Max-Planck-Institute for Plasma Physics, Garching, Ger.). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Plasma confinement and heating data are compared for the W Ib, W IIb, and W VII stellarators. Magnetic surfaces for $l = 2$ and $l = 3$ configurations are shown. (MOW)

30901 (CONF-730315-, pp vp. Sect. E1-I) SOME ASPECTS OF PSEUDOCLASSICAL DIFFUSION IN A TOKAMAK. Galeev, A. A. (Inst. of High Temperatures, Moscow). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Artsimovich earlier described the electron energy losses in a tokamak by the following formula for electron heat conductivity ("pseudoclassical diffusion") $\chi_e = 5\,\nu_{eff}\,\rho_{e\vartheta}^2$ where: ν_{eff}—the effective electron collision frequency, calculated from the data for an electrical plasma conductivity $\sigma_{exp} = ne^2/m\,\nu_{eff}$; $\rho_{e\vartheta} = (mc^2T_e)^{1/2}/eB_\vartheta$—electron larmor radius in a poloidal magnetic field, created by the toroidal plasma current. Experiments on the ST-tokamak have verified this formula. (auth)

30902 (CONF-730315-, pp vp. Sect. E4-I) HEATING OF PLASMA IN STELLARORS. Tolok, V. T.; Suprunenko, V. A. (Physical-Technical Inst., Kharkov). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Some experimental results for turbulent heating by currents in the GROM-3, Uragan, and Sirius stellarators are described. (auth) or (MOW)

30903 (CONF-730315-, pp vp. Sect. E8) NEUTRAL BEAM INJECTION OF TOKAMAKS. Stewart, L. D.; Callen, J. D.; Clarke, J. F. (Oak Ridge National Lab., TN). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

A basic ORMAK neutral injection heating module has been developed which is capable of delivering 120 kW to the plasma with acceptable levels of impurities and streaming neutral gas. Independent variation of the energy, power, equivalent current, neutral species, time of injection and angle of injection will be possible. Significant increases in ion temperatures are expected when using these heaters. Plasma perturbations caused by injection of a neutral beam into a tokamak plasma are examined to determine if there are any limitations on this method of heating and replenishing the plasma. The use of feedback controlled neutral injection heating was studied for stabilizing the operating temperature in a test fusion reactor design. (auth)

30904 (CONF-730315-, pp vp. Sect F1-I) NEO-CLASSICAL THEORY FOR NONAXISYMMETRIC SYSTEMS. Stringer, T. E. (Culham Lab., Abingdon, Eng.). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The neoclassical theory for diffusion in a stellarator is reviewed. The diffusion-driven current is shown to be similar to that in a comparable Tokamak. The effect of the magnetic field ripples, resulting from the spacing between field coils in a Tokamak, is discussed. (auth)

30905 (CONF-740316-3) PROPERTIES OF RF-CONFINED PLASMAS. Hatch, A. J. (Argonne National Lab., Ill. (USA)). 1974. 33p. Dep. NTIS $3.75.

From conference on electrostatic and electromagnetic confinement of plasmas and the phenomenology of relativistic electron beams; New York, New York, USA (4 Mar 1974).

An experimental study was made which confirms the theoretical prediction of confinement of low-density plasmas ($n < n_c$) at sufficiently low pressure in an electric quadrupole field having a Φ potential well. A cylindrical resonant cavity 36 cm in diameter and 24 cm long was used. When excited in the electric dipole TM_{010} mode (nonconfining) at 644 MHz, no breakdown or discharge could be observed at pressures below that corresponding to the electron mean-free-path limit of the diffusion mechanism of rf breakdown. However, when excited in the electric quadrupole TM_{011} mode (confining) at 902 MHz, breakdown and discharge were observed at pressures down to 3 decades below the m.-f.-p. limit. Observations of the discharge luminosity in the TM_{011} mode showed a minimum at the center of the Φ well at a pressure above the m.-f.-p. limit and a maximum below the limit. As pressure was reduced, the floating potential of a probe at the center of the Φ well showed a change from + to – at a pressure about 1 decade below the m.-f.-p. limit. A simple analysis of stochastic heating of electrons by collisions with neutrals indicates that the cycling "lifetime" of confined electrons is of the order of microseconds. (auth)

30906 (IPP-1-141) INVESTIGATION OF FAST MAGNETIC COMPRESSION AS METHOD FOR GENERATING A HOT WEAKLY COMPRESSED PLASMA. Soeldner, F. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Jan 1974. 55p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

The fast magnetic compression of a low density plasma ($n_0 \approx 2 \times 10^{13}$ cm^{-3}) and its moving into equilibrium are investigated in a high voltage theta pinch ($U_{0,max} = 500$ kV). Electron density and temperature are measured by ruby laser light scattering. Ions are reflected from the magnetic piston during compression (about 30% reflection degree) resulting in strong ion heating. (auth)

30907 (UCID-16164(Rev. 1)) INITIAL HEATING RATE OF A DROPLET IN A SPHERICAL MICROWAVE CAVITY. Garelis, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1974. Contract W-7405-eng-48. 26p. Dep. NTIS $4.50.

A simple analytical relationship for the Q of a resonant spherical cavity with a central droplet is derived assuming superconducting cavity walls. It is assumed that the skin depth, δ, is small compared to the droplet radius, a, and that the wave length, $\lambda = 2\pi c/\omega$, be small compared to the cavity radius, b, and large compared to the droplet radius. The equation is $Q = (bc^2)/(a^2\delta\omega^2)$. (auth)

30908 PLASMA HEATING BY A RELATIVISTIC ELECTRON BEAM. Abrashitov, Yu. I.; Koidan, V. S.; Konyukhov, V. V.; Lagunov, V. M.; Luk'yanov, V. N.; Mekler, K. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 11, 395-397(5 Dec 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 11, 675-679(5 Dec 1973).

Experimental results pointing to the possibility of heating a sufficiently dense plasma ($n \sim 10^{14}$ cm^{-3}) by a powerful relativistic electron beam are described. (auth)

30909 OBSERVATIONS ON MIRROR LOSSES. Hiskes, J. R.; Futch, A. H. (Univ. of California, Livermore). Nucl. Fusion; 14: No. 1, 116-119(Jan 1974).

Several mirror experiments are discussed that have mean ion energies near 1 to 2 keV for which the plasma decays in an apparently quiescent manner, and for which the loss rate is not the charge exchange rate. Loss rate function diagrams are given for five experiments. (MOW)

30910 RADIATION LOSSES FROM NON-STATIONARY PLASMAS DUE TO OXYGEN IMPURITIES. Duechs, D.; Engelhardt, W.; Koeppendoerfer, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 14: No. 1, 73-78 (Jan 1974).

Observations of theta-pinch plasmas were followed up by calculating the energy losses due to resonance line radiation from oxygen impurities. A plasma, homogeneous in density and temperature, was assumed to be heated instantly from a low initial temperature to a certain high temperature. The oxygen atoms are thereby ionized over different ionization stages until equilibrium conditions are reached. On the assumption of prevailing binary collisions a normalized density-independent time and a normalized density-independent emission coefficient can be introduced. Three-body collisions and stepwise excitation in lithium-like ions limit this scaling to electron densities below 10^{16} cm^{-3}. With the help of these results an estimate of the energy losses by line radiation due to oxygen impurities in non-stationary plasmas like pinches, tokamaks and stellarators is possible provided the impurity concentration and the electron density and temperature are known from measurements. (auth)

30911 ANOMALOUS PLASMA HEATING AT LOWER HYBRID FREQUENCY. Satya, Y.; Sen, A.; Kaw, P. (Physical Research Lab., Ahmedabad, India). Nucl. Fusion; 14: No. 1, 19-23(Jan 1974).

An investigation is made of the heating of plasmas by an oscillating electric field close to the lower hybrid frequency. In the presence of low-frequency short-wavelength background fluctuations, the electric field can become anomalously absorbed because of resonant transfer of energy to damped lower hybrid modes. This results in an efficient heating of the ions in the plasma. (auth)

30912 COLLISIONAL LOSSES OF ELECTRONS FROM AN ADIABATIC TRAP IN A PLASMA WITH A POSITIVE POTENTIAL. Pastukhov, V. P. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 14: No. 1, 3-6(Jan 1974).

Analytical expressions are obtained for the collisional losses of electrons and their energy from an adiabatic trap when the plasma has a high positive potential. The expressions are derived on the basis of an approximate solution of the Fokker–Planck equation, which yields more reliable results than those obtained with the estimative formulas used in a number of other works. In addition, an expression is obtained for the mean energy of the electrons escaping from the trap. (auth)

30913 PLASMA CONFINEMENT STUDIES IN HELIOTRON-D. Iiyoshi, A.; Morimoto, S.; Konoshima, S.; Yoshioka, S.; Sato, M.; Ohtake, I.; Yamada, M.; Uo, K. (Kyoto Univ.). Nucl. Fusion; 14: No. 1, 7-12(Jan 1974).

Recent plasma confinement experiments in Heliotron-D are described in connection with neoclassical diffusion theory. Weakly and relatively strongly ionized plasmas are produced by coaxial-gun and Joule heating, respectively. In both cases, the observed diffusion coefficients are found to be in good agreement with the theory, under the conditions of weak magnetic field. Diffusion processes in two different magnetic configurations, $\epsilon_t \sim \epsilon_h$ and $\epsilon_t \ll \epsilon_h$, are also compared experimentally, where ϵ_t is the ratio r/R of the distance from the magnetic axis to the major radius, and ϵ_h is the modulation depth due to the helical field. (auth)

Diagnostics

30914 (AD-770696) INJECTION OF SMALL MACROSCOPIC PARTICLES IN PLASMA AS A DIAGNOSTIC TECHNIQUE. Anestos, T. C.; Hendricks, C. D. (Illinois Univ., Urbana (USA)). Aug 1973. 88p. (CPRL-3-73; UILU-ENG-73-2556; AFOSR-TR-73-2069). NTIS $3.75.

A method for the determination of the electron temperature of a plasma by measuring the charge acquired by a small spherical macroscopic particle of the order of 25 micron diameter as it travels through the plasma is investigated. The particles are generated by the electromechanical breakup of a liquid jet. The plasma is created inside a cylindrical magnetron, which uses crossed electric and magnetic fields. (auth)

30915 (CONF-720804-P2, pp 235) EXPERIMENTAL INVESTIGATION OF COLLECTIVE PROCESSES IN A THETA-PINCH. El-Khalafawy, T. A.; Bourham, M. A.; El-Behay, A. Z.; El-Hak, L. G.; Gabr, A. A.; Demchenko, V. V.; Ternopol, A. M. (Atomic Energy Authority, Cairo). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

Microwave probe measurements were performed on a discharge chamber. The detection of unstable electrostatic oscillations in the plasma is discussed. (MOW)

30916 (IPP-2-219) "RESI" A FIRST STAGE OF AN ONLINE DATA ACQUISITION AND ANALYSIS SYSTEM FOR LOW-β EXPERIMENTS. Rehker, S.; Zimmermann, D. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Jan 1974. 24p. (IPP-4-115). Dep. NTIS (U. S. Sales Only) $4.25.

Up to now 5 measured quantities can be digitized and stored by "RESI." A number of analysis programs are included in the sys-

tem with which the user can perform calculations from the experimental data between the shots. Hardware and software of this system are described. (auth)

30917 MICROWAVE DIAGNOSTICS OF A DEUTERIUM AFTERGLOW PLASMA. Kay, A.; Mentzoni, M. (Univ. of Oslo). Phys. Lett., 47A: No. 1, 21-22(25 Feb 1974).

The electron number density, N_e, was measured by interferometry with a signal of 9.531 GHz. The time decay of N_e indicated that electron–ion recombination was important with a recombination coefficient $\alpha_r = 1.1 \times 10^{-6}$ cm^3 sec^{-1}. (auth)

30918 MICROWAVE MEASUREMENTS OF 2XII RADIAL AND LONGITUDINAL ELECTRON DENSITY PROFILES. Simonen, T. C.; Coensgen, F. H.; Cummins, W. F.; Molvik, A. W.; Nexsen, W. W. Jr. (Univ. of California, Livermore). Nucl. Fusion; 14: No. 1, 61-66(Jan 1974).

Five microwave interferometers are used to measure radial and longitudinal electron density profiles versus time in the 2XII minimum-B mirror containment experiment. The mean plasma radius determined from a radially offset interferometer agrees with electrostatic probe and laser measurements. The longitudinal profile is consistent with a collisional ion angular distribution with a density at the mirrors of approximately 5% of the central density. After compression the plasma shape remains approximately constant. Plasma densities beyond the mirrors were less than 5% of the central density. (auth)

Kinetics (General)

30919 (AD-763827) GUIDANCE OF HIGH-VOLTAGE ELECTRICAL BREAKDOWN STREAMERS BY LASER INDUCED IONIZATION IN AIR. Final Scientific Report. Markels. (Versar, Inc., Springfield, Va. (USA)). 30 Jun 1973. Contract F44620-70-C-0077. 63p. (AFOSR-TR-73-1209). NTIS $5.25.

Experimental studies and theoretical analysis have shown that the breakdown path and propagation velocity of high voltage electrical streamers can be modified and controlled by laser radiation at intensities less than the optical breakdown threshold. In air at atmospheric pressure, 450 KV negative streamers have been guided along straight paths about 70 cm in length, and the propagation velocities of the streamers have been increased from 2×10^7 cm/sec to 3×10^8 cm/sec, by 1.06 micrometer radiation pulses of 200 Joules energy and 60 nsec half-width. Direct measurements of the degree of ionization along the laser beam path showed about 10^{10} to 10^{11} ion pairs/cc are produced at the beam intensities used in the studies. (auth)

30920 MEASUREMENTS AND INTERPRETATION OF PLASMA POLARIZATION SHIFT FOR MEMBERS OF THE RESONANCE SERIES OF IONIZED HELIUM. Gabriel, A. H.; Volonte, S. (Science Research Council, Abingdon, Eng.). 6: No. 12, 2684-2700(Dec 1973).

Using an improved T-tube to produce high density helium plasmas, a high density effect connected with the presence of perturbers in the vicinity of a radiating ion was studied. This effect, the plasma polarization shift, involves the shift of a line under the influence of a perturbing electron. When this electron is considered as bound and forms with the radiating electron a doubly excited state of the ion, the effect corresponds to the emission of dielectronic satellites and is shown to be negligible. When the additional electron is treated as a free perturber the approach of Greig et al (Phys. Rev. Lett.; 24: 3-5 (1970)) predicts a blue shift as observed here. The predicted n scaling is confirmed but absolute agreement is very poor either with this approach or that modified by Burgess and Peacock (J. Phys. B., Atom. Molec. Phys.; 4: L94-7 (1971)). Better agreement is obtained for high n shifts with this approach as modified by Griem. However a recent quantum treatment of Griem leads to the best overall agreement. The red shifts measured for the optically thick lower series members are shown to originate in far wing asymmetries due to higher order effects usually neglected in hydrogenic Stark profiles. (auth)

30921 POWER LAW OF EXCITED-STATE POPULATION DURING INJECTION. Lodge, J. G. (Univ. of Stirling, Scotland). Nucl. Fusion; 14: No. 1, 122-123(Jan 1974).

The population of excited states produced by charge transfer when a proton beam passes through a gas cell is of the order of n^{-3}. The population law also holds for neutral beam injection into a plasma. The determination of the law from the excitation cross section for ion–neutral collisions is discussed. (MOW)

Kinetics (Experimental)

30922 (AD-770195) BOUND–BOUND RADIATION/COLLISIONAL RADIATIVE RECOMBINATION IN OXYGEN AND NITROGEN PLASMAS. Topical Report, 1 January–30 June 1973. Jones, L. A.; Griem, H. R.; McLean, E. A. (Naval Research Lab., Washington, D. C. (USA)). 24 Sep 1973. 21p. (DNA-3163-T). NTIS $2.75.

An existing theta-pinch device has been modified to produce a low density, slowly decaying, nonthermal plasma. Using this plasma as a light source, the absolute intensity of visible line radiation originating, via dipole transitions, from the upper levels of interest can be measured. These measurements in conjunction with known atomic transition probabilities directly yield the population number densities of these upper levels. Laser scattering has been used as a diagnostic tool. (GRA)

30923 OBSERVATION OF A STATIONARY SHOCK-LIKE STRUCTURE AND ENHANCED DIFFUSION IN A TOROIDAL PLASMA. Mohri, A.; Fujiwara, M. (Nagoya Univ., Japan). Nucl. Fusion; 14: No. 1, 67-72(Jan 1974).

Electrons are injected into an afterglow plasma confined in an l = 3 stellarator in order to raise the velocity of poloidal rotation. A steady shock-like structure characterized by a steep density gradient is observed near the critical rotational speed. Strong enhancement of the diffusion rate occurs at higher radial electric fields, accompanied by large-amplitude density fluctuations. Vortices are generated at the three corners of the triangular magnetic surfaces when the radial electric field is reversed inside the plasma. (auth)

Kinetics (Theoretical)

30924 (CONF-720804-P2, pp 93-104) RECENT DEVELOPMENTS IN COMPUTER SIMULATION OF PLASMAS. Biskamp, D.; Chodura, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

The particle-in-cell method for plasma simulation is briefly discussed along with the clouds-in-cell method. Diagrams are shown for the Coulomb collision cross section in two and three dimensions. Some of the problems of computer simulation using these methods are described. (MOW)

30925 (CONF-720804-P2, pp 105-118) ANOMALOUS RESISTIVITY IN PLASMA. Sagdeev, R. Z. (Univ., Rennes, France). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

The critical discussion of present state understanding of anomalous resistivity problem is given. Different types of instabilities, invoked in the problem, and their nonlinear saturation are considered. (auth)

30926 (CONF-720804-P2, pp 233) TOKAMAK TWO-FLUID CODE: EFFECTS OF NEUTRAL BEAM HEATING, RADIATION LOSS, AND CHARGE EXCHANGE. Hogan, J. T.; Dory, R. A. (Oak Ridge National Lab., TN). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

30927 (CONF-730315-, pp vp. Sect A5) NEW RESULTS FROM THE HIGH BETA TOROIDAL PINCH EXPERIMENT. Crow, J. E.; Gowers, C. W.; Newton, A. A.; Robinson, D. C.; Verhage, A. J. L.; Bodin, H. A. B. (Culham Lab., Abingdon, Eng.). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Further studies of reversed field pinches, observed experimentally to remain stable for 30 to 40 μsec, are reported. The results of numerical simulations of the setting up phase are compared with measurements and new observations reported on discharges with currents up to 100 kA. Changes in the stability behavior as the current is increased are discussed. (MOW)

30928 (CONF-730315-, pp vp. Sect. B10-I) NUMERICAL CALCULATIONS OF THE RADIAL TRANSPORT IN TOKAMAK DISCHARGES. Duechs, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.); Furth, H. P.; Rutherford, P. H. [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The neoclassical theory for radial transport in tokamaks is briefly discussed. The effects of neutral atoms and impurities are also considered. Some empirical models for transport coefficient calculations are described. (MOW)

30929 (CONF-730315-, pp vp. Sect. C1-I) GAS BLANKET CONCEPT. Lehnert, B. (Royal Inst. of Tech., Stockholm). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

A review is given on the equilibrium and stability properties of quasi-stationary magnetically confined plasmas interacting with

neutral particles which originate from a surrounding gas blanket or are formed by plasma-wall interaction. (auth)

30930 (IPP-2-217) RATE COEFFICIENTS FOR INTERACTION OF MONOENERGETIC PARTICLE BEAMS WITH MAXWELLIAN PLASMAS. Rehker, S.; Speth, E. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Jan 1974. 17p. Dep. NTIS (U. S. Sales Only) $4.00.

Rate coefficients and mean free paths for the interaction of a monoenergetic hydrogen atom beam with a Maxwellian hydrogen plasma are calculated taking into account charge exchange and impact ionization by electrons and ions in the following temperature and energy range: T = 1 eV to 100 keV (nonrelativistic) and E = 1 eV to 100 keV. (auth)

30931 SIMPLE MODEL FOR SPECTRA OF LASER RADIATION BACKSCATTERED FROM AN UNSTABLE INHOMOGENEOUS PLASMA. Martineau, J.; Bobin, J. L. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). Phys. Lett., 47A: No. 1, 43-44(25 Feb 1974).

It is shown that phase modulation causes the occurrence of harmonics and satellites in the reflected spectrum and subharmonics and harmonics of half integer order in the Raman scattered light. (auth)

30932 NONLINEAR EFFECTS IN THE PROBLEM OF THE ANOMALOUS PLASMA RESISTANCE. Vekshtein, G. E. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 2, 588-593(Feb 1974). (In Russian).

Nonlinear processes arising in a plasma located in a stationary homogeneous electric field are considered on basis of the asymptotic theory of anomalous resistance. It is shown that in sufficiently strong fields, nonlinear effects determine the time of transition of the system to an asymptotic regime. (auth)

30933 INFLUENCE OF IONIZATION PHENOMENA ON THE INTERACTION OF A SHOCK-GENERATED PLASMA WITH A MAGNETIC FIELD. Sardei, F. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 556-567 of Recent Developments in Shock Tube Research. Bershader, D. (ed.). Stanford, CA; Stanford University Press (1973).

The transient processes of the interaction between plasma flows behind strong shock waves and transverse magnetic fields were investigated theoretically and compared with experimental results. Calculation of the interaction was allowed by deriving characteristic relations for real gas behavior (i.e., for variable ionization parameters) from the flow equations. When perfect gas conditions are assumed, the calculations correctly describe only the essential integral effects of the interaction process. By making allowance for ionization and relaxation effects, one can also reproduce correctly details of the non-stationary phase of the reflection process. The influence of relaxation behind the primary shock on the reflection process was taken into account by inserting the current distributions measured at the electrodes as functions of space and time. The calculations showed that the relaxation causes a delay of nearly 100 μsec (compared to perfect gas predictions) in the formation of the reflected shock (at shock Mach numbers of about M = 10 and upstream pressures of about p_0 = 10 torr). Furthermore, the place of origin in the interaction region is shifted downstream. A comparison between the calculated and measured results yielded quantitative agreement not only for the slope, but also for the point of origin of the reflected shock in the space-time plane. (auth)

30934 KINETIC EQUATION AND THE EQUATION OF MOMENTUM TRANSFER FOR A PLASMA. Majumdar, S. K. (Saha Inst. of Nuclear Physics, Calcutta). Pramana; 1: No. 3, 129-134(Sep 1973).

An attempt was made to derive a simple form of the collision integral of the kinetic equation for a plasma by using Rostoker's equation which expresses the pair correlation function in terms of the distribution functions of the particles, and the conditional probability of one particle shielding the other. The conditional probability function is assumed to be given by its equilibrium value. By taking first order velocity moment of the resulting kinetic equation, the equation of momentum transfer was obtained. (auth)

Production

Refer also to abstract 30872.

30935 (CONF-720804-P2, pp 171-182) LASER-CREATED PLASMAS AND CONTROLLED THERMONUCLEAR FUSION. Bobin, J. L. (CEA, Villeneuve-Saint-Georges, France). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

Current data about lasers and laser-created plasma experiments are given. Possible mechanisms leading to neutron emission from such plasmas are discussed. Proposals for the use of laser-created plasmas in controlled fusion systems are reviewed. (auth)

30936 (JPRS-61638) STUDY OF THE PARAMETERS AND DYNAMICS OF A LASER PLASMA. Boyko, V. A.; Krokhin, O. N.; Sklizkov, G. V. (AN SSSR, Moscow. Fizicheskij Inst.). 2 Apr 1974. Translation of Preprint No. 121, 73p. NTIS.

The characteristic parameters are described for the following: a laser flare, plasma temperature measurements, the anisotropy of the separation of the laser flare ions, the ionization state of multicharge laser plasma, and laser plasma as a source of multicharge ions. (auth)

30937 THEORY OF HOMOGENEOUS ISENTROPIC COMPRESSION AND ITS APPLICATION TO LASER FUSION. Kidder, R. E. (Univ. of California, Livermore). Nucl. Fusion; 14: No. 1, 53-60(Jan 1974).

The hydrodynamic theory and properties of spherical homogeneous isentropic compression are discussed. Computer results are described showing that a close approximation to compressions of this type may be accomplished by light-induced pellet ablation if the light absorbed by the pellet is properly programmed with time, and is spatially uniform over the pellet surface. Pellet compressions in excess of ten thousand-fold are computed. (auth)

Stability

Refer also to abstracts 30893, 31003, 31035, and 31037.

30938 (CONF-720804-P2, pp 47-58) HIGH BETA TOROIDAL EXPERIMENT. Robinson, D. C.; Crow, J. E.; Gowers, C. W.; Nalesso, G. F.; Newton, A. A.; Verhage, A. J. L.; Bodin, H. A. B. (Culham Lab., Abingdon, Eng.). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

The setting up and MHD stability of diffusing pinch configurations has been studied. For a reverse field pinch the axial flux should not change sign and decay for the maximum stable time. Conditions for setting up such a stable distribution are discussed and experiments described in which configurations are generated without instability. The plasmas have $\beta_\theta \sim 0.6$ and provided the axial flux is positive, the lifetime can be 30 to 40 μs which corresponds to the computed classical resistive decay time of the fields. The configuration is not perfectly MHD stable but the localized modes predicted are not observed and may be stabilized by finite larmor radius effects. (auth)

30939 (CONF-720804-P2, pp 235) MODE COUPLING IN DYNAMIC STABILIZATION OF MHD MODES. Part II. Becker, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

30940 (CONF-720804-P2, pp 236) DYNAMIC STABILIZATION EXPERIMENTS ON A SCREW PINCH WITH STANDING WAVE MAGNETIC FIELDS. Part II. Becker, G.; Gruber, O.; Herold, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). 1972.

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

The dynamic stabilization experiments described in the first part of the proceedings are extended to values of $\epsilon = (\tilde{B}_z/B_{z0})_{max}$ up to 0.26 in a shorter θ pinch coil. Also the distortion δ_0 of the plasma normalized to the plasma radius in a bulge of the standing wave field has been measured. The parameters of the two experiments are shown. (auth)

30941 (CONF-721111-, pp 48-62) NUMERICAL ANALYSIS OF THERMAL STABILITY IN AN INHOMOGENEOUS D-T FUSION PLASMA. Yamato, H.; Ohta, M.; Mori, S. (Japan Atomic Energy Research Inst., Tokai). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Thermal stability in a radially inhomogeneous plasma in a D-T fusion reactor is analyzed by solving the diffusion and the heat-conduction equations numerically. When the injection of fuel is uniform, the plasma can be unstable only for the zeroth order mode; i.e., the mode in which the temperature deviations increase throughout the plasma radius and high-order modes are always stable. This fact is clearly shown when perturbations of various mode numbers are applied. The stability criteria are

similar to those found previously in the uniform plasma. The critical temperature above which the plasma is stable is obtained. It is shown that feedback stabilization can also be applicable. For the nonuniform injection of fuel, especially for surface injection, the temperature and density distributions are obtained. The results obtained so far seem to suggest that stable equilibria of the distribution may be possible for surface injection. (auth)

30942 (CONF-730315-, pp vp. Sect A7) TOROIDAL EQUILIBRIA OF PLASMAS WITH $\beta = 1$ AND STRONGLY NONCIRCULAR CROSS SECTION. Janicke, L. (Kernforschungsanlage, Juelich, Ger.). [nd].

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

By means of numerical calculations for $\beta = 1$ plasmas the question is checked how the form of a plasma cross section in configurations similar to the Tokamak may be influenced. Special attention is drawn to cross sections as ellipse, triangle, or banana and the influence of the compression ratio is discussed. (auth)

30943 (CONF-730315-, pp vp. Sect B2) EFFECT OF A CONDUCTING SHELL ON THE STABILITY OF A TOROIDAL PLASMA. Vlasenkov, V. S.; Leonov, V. M.; Merezhkin, V. G.; Mukhovatov, V S. (Inst. of Atomic Energy, Moscow). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The discharge characteristics in the T-6 Tokamak as a function of a/b at $1 < q(a) < 3$ was investigated (a and b are the radii of the plasma column and the conducting shell, respectively). The variation of a/b was found to have an essential effect on macroscopic stability of the plasma column in the range $1 < q(a) < 2$. (auth)

30944 (CONF-730315-, pp vp. Sect. B21) INTERPRETATION OF MAGNETIC DISTURBANCES OBSERVED IN TOKAMAKS. Rutherford, P. H. (Princeton Univ., NJ). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

In the constant current phase of tokamaks, small-amplitude, slow growing, kinklike m = 2 to 4 magnetic perturbations are observed, followed by more violent "disruptive" instabilities which are accompanied by inward shifts in major radius and negative voltage spikes. An interpretation of the m = 2 to 4 perturbations as resistive tearing modes is supported by linear stability criteria evaluated for the equilibrium current profiles typical of present tokamaks. It is shown that the mode amplitudes, and their long-time integrity, may be explained by nonlinear restraints on tearing-mode growth: nonlinear eddy currents arise near the singular surface, producing $\vec{j} \times \vec{B}$ forces which replace the inertia in opposing the vortex-flow associated with the tearing mode. (auth)

30945 (CONF-730315-, pp vp. Sect. B22) NONLINEAR THEORY OF m = 1 KINK MODE. Rosenbluth, M. N. (Inst. for Advanced Study, Princeton, NJ); Dagazian, R.; Rutherford, P. [nd].

From third international symposium on toroidal plasma confinement, Garching, F. R. Germany (26 Mar 1973).

A neighboring helical equilibrium is found to result from the m = 1 kink instability. The amplitude of the helix is approximately $\xi = 3(r/R)^2\beta_0$. Negative voltage spikes and inward radial shifts are predicted as seen in the "disruptive instability" but the predicted signals are too small. (auth)

30946 (CONF-730315-, pp vp. Sect. F2-I) THEORETICAL RESULTS OF MHD STABILITY OF TOKAMAK EQUILIBRIA WITH SHAPED CROSS SECTIONS. Laval, G. (Ecole Polytechnique, Paris); Pellat, R.; Soule, J. L. [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Equations showing the effect of toroidal configuration on the plasma equilibria and stability are described. Plasma properties in an elliptical tokamak are briefly discussed. (MOW)

30947 (CONF-730315-, pp vp. Sect. F3) EFFECTS OF NEUTRAL INJECTION UPON TOROIDAL PLASMA EQUILIBRIA. Connor, J. W.; Cordey, J. G. (Culham Lab., Abingdon, Eng.). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The equilibrium distribution functions of the three species of plasma (high energy ions, background ions, and electrons) are derived. First, the high energy ion distribution is found from a solution of an appropriate Fokker–Planck equation which takes into account the toroidal geometry, then the plasma current is calculated from the electron distribution function. Finally the influence of ripples in the toroidal field upon the toroidal velocity of the background plasma is evaluated. (auth)

30948 (IPP-1-140) ANALYTIC STUDY OF MHD EQUILIBRIA OF THE BELT PINCH IN "BELT-PINCH COORDINATES." Becker, G. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Jan 1974. 39p. Dep. NTIS (U. S. Sales Only) $5.00.

MHD equilibria for belt-pinches with arbitrary half-axis ratios a/b were studied by analytic methods. A straight pinch with sharp pressure profile, an axial surface current on a perfectly conducting plasma and a closed, perfectly conducting wall are assumed. The calculation is made in coordinate systems where plasma surface and wall are coordinate surfaces. (auth)

30949 EFFECT OF COLLISIONS OF THE CURRENT-DRIVEN ION-WAVE-INSTABILITY. Ishihara, O.; Watanabe, S.; Tanaca, H. (Yokohama National Univ., Japan). Nucl. Fusion; 14: No. 1, 13-17(Jan 1974).

The effect of collisions on the onset of the current-driven ion-wave instability is experimentally investigated in a diffusion plasma. The critical wavenumber of the instability decreases when the collisional parameter $\omega_{pi}\tau_i$ increases from 20 to 120, in good agreement with theory. (auth)

30950 GUIDING-CENTER DIFFUSE PINCH AND LOCAL INSTABILITY. Pao, Y. P. (New York Univ.). Nucl. Fusion; 14: No. 1, 25-32(Jan 1974).

The stability problem of a linear diffuse pinch is studied by a normal-mode analysis using guiding-center theory. The general normal-mode equation capable of determining the growth rate is obtained. The guiding-center Suydam instability and the associated eigenvalue (growth rate) are examined. (auth)

30951 ABSOLUTE PARAMETRIC INSTABILITIES IN INHOMOGENEOUS PLASMAS. White, R.; Kaw, P.; Pesme, D.; Rosenbluth, M. N.; Laval, G.; Huff, R.; Varma, R. (International Centre for Theoretical Physics, Trieste, Italy). Nucl. Fusion; 14: No. 1, 45-51(Jan 1974).

The excitation of absolute instabilities in three-wave parametric coupling processes in inhomogeneous plasmas was studied analytically. A detailed examination of the full fourth-order set of differential equations describing such processes in infinite media confirms the WKB-criterion that absolute instabilities arise only if $d(\Sigma k_i)/dx = 0$. A model calculation using the WKB-approximation was also carried out to study the effects of finite plasma extent and pump depletion; conditions for the excitation of absolute instabilities in this case were also obtained. (auth)

30952 STABILITY OF EXACT TOROIDAL MHD-EQUILIBRIUM WITH NON-CIRCULAR CROSS-SECTION. Herrnegger, F.; Maschke, E. K. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 14: No. 1, 119-121(Jan 1974).

In recent experiments on toroidal plasma confinement, the aspect ratio is relatively small so that the usual expansions of equilibrium solutions in powers of the inverse aspect ratio are not applicable. A class of exact solutions has recently been found by the authors. A very simple particular solution has a bell-shaped current distribution and seems useful for the description of equilibria of the tokamak or pinch type. The stability of this particular solution is investigated against localized modes by applying Mercier's criterion in the neighborhood of the magnetic axis. It is shown that this solution is unstable for a plasma with vertically elongated cross-section, as, e.g., the belt pinch. It is then shown that it is possible to construct a stable solution by an appropriate superposition of two exact solutions. (MOW)

30953 ELECTROSTATIC OSCILLATIONS AND FEEDBACK CONTROL OF A LOSSFREE PLASMA. Kitao, K. (Niigata Univ., Japan). J. Phys. Soc. Jap.; 35: No. 1, 272-276(Jul 1973).

The general features of the electrostatic oscillations in a lossless plasma are discussed from the dispersion relation and energy equation. It is shown that the unstable electrostatic waves in lossless plasma have always zero energy density which is realized as a sum of a negative kinetic energy density and a positive electrostatic energy density. The feedback stabilization for reactive instabilities is reconsidered by a simple model, and a cold electron plasma–beam system is studied as a simple example. (auth)

30954 STREAM INSTABILITIES IN A COLD PLASMA IN THE PRESENCE OF A MAGNETIC FIELD. Chakraborty, B. B. (Univ. of Bombay). J. Math. Phys. Sci.; 6: No. 4, 419-424(1972).

The stream instability of a cold plasma was studied against plane waves of disturbances of perpendicular propagation in the presence of a magnetic field aligned with the stream direction. When ion oscillations are neglected, the electron stream is always found to be stable. When ion oscillations are taken into account, the magnetic field and stream velocity are found to have a stabilizing and a destabilizing influence, respectively. The growth rate of instability of an unstable mode increases with the wave number. An earlier analysis of the stability problem, neglecting the displacement cur-

rent, was found to be accurate at large magnetic fields or small stream velocities, and qualitatively true at small magnetic fields or large stream velocities. (Indian Sci. Abstr.)

30955 INVESTIGATION OF ELECTRON BEAM–PLASMA INTERACTIONS. Kainer, S. New York; New York Univ. (1973). 163p. University Microfilms Order No. 74-1908.

Thesis (Ph. D.).

This investigation is concerned with the interaction of a highly energetic beam with a relatively dense background plasma studied through numerical experiments using one-dimensional electrostatic codes. The experiments primarily involved nonrelativistic beam velocities and ions considered as a fixed background. Extensions were also made to include both relativistic energies and heavy mobile ions. The experiments indicate that the initial instability arises from the two-stream instability with the initially most unstable wave dominating and the growth rates agreeing with those given by the linear theory. The electric field of the growing wave broadens the beam symmetrically about its phase velocity eventually leading to nonlinear effects due to trapping and to saturation. It was found that the phenomena depend critically upon the relative beam density. From simple energy and momentum considerations, it was found that for beams with a relative density of 3.8% and higher, the amplitude of the electric field is sufficient to merge the velocity distributions of the beam and background plasma electrons before saturation of the initial instability. This merging prevents further growth of the wave energy. For lesser beam densities, trapping occurs before the merging can occur so that the system remains unstable. This division of the phenomena into high and low density regimes was verified in the numerical experiments. It was observed that the further growth of the wave energy in the low density regime was accompanied by beam broadening and that many modes were involved. It was therefore hypothesized that quasilinear theory would be able to describe this regime. This was indeed verified with the rates of beam broadening as calculated from the quasilinear theory would be able to describe this regime. This was verified with the rates of beam broadening as calculated from the quasilinear theory shown to be in good agreement with those observed in the numerical experiments. The introduction of heavy mobile ions into the background plasma was shown to lead to the ac two-stream instability and wave damping. The presence of ions however was found not to alter the distinction between high and low density regimes. Likewise the ideas concerning merging were found still to apply to relativistic beams with the critical density now becoming a function of the initial beam velocity. (Diss. Abstr. Int., B)

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Refer also to abstracts 29184, 29621, 30765, 30885, 31448, and 31483.

30956 (AD-770985) DESCRIPTION AND OPERATION OF THE MARK 1B PLASMA FOCUS RADIATION FACILITY. Van Paassen, H. L. L.; Vandre, R. H. (Aerospace Corp., El Segundo, Calif. (USA)). 30 Nov 1973. 23p. NTIS $2.75.

The 140 kJ plasma focus facility (Mk 1B) at The Aerospace Corporation produces x-ray fluences that are applicable to most radiation testing problems (e.g., integrated circuits of transistors). Although the facility has only one beryllium window for exposing 1.6-cm-dia samples to doses of 25 to 45 krad (Si) per shot, three more windows could be added and the additional samples exposed simultaneously. The facility is experiencing switch problems and is presently averaging 50 shots per week—15 shots per day for 3 or 4 days. The results of a comprehensive switch analysis should provide solutions that will significantly improve this repetition rate. (auth)

30957 (BNL-18745) CONTROLLED THERMONUCLEAR RESEARCH. Survey of Applications of Fusion Power and Technology to the Chemical and Materials Processing Industries. Bimonthly Report No. 4, January–February 1974. Steinberg, M.; Powell, J.; Beller, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 6p. Dep. NTIS $4.00.

Current efforts are directed toward processes and markets which can utilize the energy forms from fusion reactors. A list is given that outlines various products and processes which are energy-intensive. The thermal reactions may utilize energy directly or indirectly. Directly indicates that the process gas is introduced into the blanket to obtain the required energy. Indirectly indicates that the process gas is heated by heat exchange with blanket coolant gas. The heat exchange may be accomplished by regenerative pebble-bed heaters, in which alternate beds are heated by reactor coolant gas (e.g., helium). By appropriate valving, the hot bed then gives up its stored heat to the process gas while the other bed is heated. (MOW)

30958 (BNWL-B-287) PROJECTION OF GRAPHITE BEHAVIOR IN VERSION III OF THE ORNL CONCEPTUAL FUSION REACTOR. Gray, W. J.; Morgan, W. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 45p. Dep. NTIS $4.00.

Neutron spectra for this design were related to the "equivalent fission fluence for damage in graphite" (Φ_G) using group average displacement cross sections. Graphite temperatures were calculated using heat generation rates. The temperature and fluence experienced by the graphite determine the dimensional changes (and changes in other physical properties as well) for a given type of graphite. Using these two parameters, the dimensional changes for the ORNL reactor were determined using data for Type 9640 graphite which is representative of graphite that could probably be obtained in large quantities for one to two dollars per pound. (MOW)

30959 (CONF-720804-P2, pp 1-12) EXPERIMENTS ON THE ST TOKAMAK DEVICE. Stodiek, W. (Princeton Univ., NJ). 1972.

From fifth European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

Experiments in the different operating regimes of ST Tokamak are discussed. The optimum regime is limited at low density by electron runaway and at high density by radial shrinkage of the current channel, resulting in macroscopic instability. (auth)

30960 (CONF-720804-P2, pp 13-24) ADVANCE IN THE TOKAMAK PROGRAMME. Strelkov, V. S. (Inst. of Atomic Energy, Moscow). 1972.

From fifth European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

A summary of the Tokamak program is given. The main lines of research for the T-4, TM-3, T-6, TO-1, TM-1-HF, and FT-1 Tokamaks are discussed. Research progress is pointed out. (MOW)

30961 (CONF-720804-P2, pp 35-46) SURVEY OF SCYLLAC EXPERIMENTS. Jahoda, F. C.; Burnett, S. C.; Ellis, W. R. (Los Alamos Scientific Lab., NM). 1972.

From fifth European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

Scyllac research is currently divided among three major experimental efforts: (a) the 5-meter 120° toroidal sector, (b) a 5-meter linear theta-pinch with strong end mirrors, and (c) a feedback stabilization experiment on Scylla IV-3. A status report on each is given. (auth)

30962 (CONF-720804-P2, pp 183-194) RECENT PROGRESS IN RESEARCH ON PLASMA FOCUS. Maisonnier, C.; Pecorella, F.; Rager, J. P.; Samuelli, M. (CNEN, Frascati, Italy). 1972.

From fifth European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

For dense plasma focus experiments, a model in which the plasma column is disrupted after maximum compression (first neutron burst) by m = 0 instabilities, and later heated to higher temperatures by turbulent mechanisms (second neutron burst), is shown to check well with experimental observations. The scaling laws of plasma focus devices are deduced. They compare satisfactorily with the available experimental scaling laws. The main parameters of the Megajoule experiment to be built in Frascati within the framework of a joint European program are indicated. (auth)

30963 (CONF-720804-P2, pp 195-211) EUROPEAN COMMUNITY ACTIVITIES IN THE FIELD OF CONTROLLED THERMONUCLEAR FUSION. Palumbo, D. (Commission of European Communities, Brussels). 1972.

From fifth European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

The motives, development, structure, and content of the EAEC (Euratom) program in the field of plasma physics and CTR are reviewed. (MOW)

30964 (CONF-720804-P2, pp 213-220) RESEARCH AND PROSPECTS ON CONTROLLED THERMONUCLEAR FUSION IN THE USA. Gould, R. W. (Atomic Energy Commission, Washington, DC). 1972.

From fifth European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

The three main lines of research in the US concerning magnetic confinement are discussed. These are magnetic mirrors, pulsed high-beta pinch systems, and near steady-state toroidal systems. In addition, a program of laser-initiated fusion is discussed. (MOW)

30965 (CONF-720804-P2, pp 221-230) RESEARCH AND PROSPECTS ON CONTROLLED THERMONUCLEAR FUSION IN USSR. Artsimovich, L. A. (Inst. of Atomic Energy, Moscow). 1972.

From fifth European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972).

The USSR program on toroidal magnetic systems, open magnetic mirrors, and laser-produced plasmas is briefly discussed. The discussion mainly considers confinement, heating, and instabilities in the various experiments. (MOW)

30966 (CONF-720804-P2, pp 239) INTENSITY ANISOTROPY AND FINE STRUCTURE IN THE X-RAY IMAGES OF THE DENSE PLASMA FOCUS. II. Bostick, W. H.; Nardi, V.; Prior, W. J.; Rodriquez-Trelles, F. (Stevens Inst. of Tech., Hoboken, NJ). 1972.

From fifth European conference on controlled fusion and plasma physics, Grenoble, France (21 Aug 1972).

The intensity anisotropy of localized x-ray sources is numerically estimated from several films all obtained under similar conditions. (auth)

30967 (CONF-721111-) TECHNOLOGY OF CONTROLLED THERMONUCLEAR FUSION EXPERIMENTS AND THE ENGINEERING ASPECTS OF FUSION REACTORS. Proceedings of a Symposium Held at Austin, Texas, November 20-22, 1972. AEC Symposium Series 31. Draper, E. L. Jr. (ed.). (Texas Univ., Austin (USA)). Apr 1974. 1052p. Dep. NTIS $16.60.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

Separate abstracts were prepared for 32 of the 59 papers. The remaining papers appeared previously in NSA. (MOW)

For abstracts of individual papers see: 29621, 30881-30886 30941, and 30968-30991.

30968 (CONF-721111-, pp 63-85) EFFUSION-PERMEATION EXTRACTOR SYSTEM. Parkin, L. P.; Impink, A. J. Jr. (Carnegie-Mellon Univ., Pittsburgh). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

As a possible approach to the problem of fuel and waste extraction from the periphery of closed-line continuous-mode fusion power reactors, an extractor system based on a combination of permeation and effusion processes has been investigated. Preliminary analytical results indicate that acceptable partial pressures of all fuel and waste species can be maintained in reference configurations with a minimum of interference with other necessary functions of conventional blanket configurations. Proper selection of sweep-gas constituents leads to minimal interaction of the extractor system with the reacting plasma. (auth)

30969 (CONF-721111-, pp 92-104) TRITIUM INVENTORIES AND LEAKAGE: A REVIEW AND SOME ADDITIONAL CONSIDERATIONS. Hansborough, L. D. (Univ. of Texas, Austin). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Past estimates of tritium inventories and leakage have been based on uncertain tritium solubility and permeation data with blanket sizes that are now considered unacceptably small. The tritium distribution in a 1000-MW(th) reference fusion-reactor plant employing a helium-cooled lithium blanket with a niobium structure is analyzed. An external tritium window is required for tritium recovery from the lithium if permeation rates are linearly dependent on the tritium partial-pressure difference across niobium walls, and the total tritium inventory is 3.87 kg. If permeation rates are dependent on the difference of the square root of the tritium partial pressure across niobium walls, direct tritium recovery from the blanket is possible, and the total tritium inventory is 2.15 kg. Total tritium leakage from the reference reactor is estimated at less than 4 Ci/day. Tritium permeates to the steam system at a rate of 2.45 Ci/day, which results in contamination of the steam system and possible contamination of the steam-system cooling water. (auth)

30970 (CONF-721111-, pp 132-145) FUSION-FISSION BREEDER; ITS POTENTIAL IN A FUEL-STARVED THERMAL REACTOR ECONOMY. Draper, E. L. Jr.; Gage, S. J. (Univ. of Texas, Austin). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Although eventual development of a safe commercial liquid-metal fast breeder reactor (LMFBR) appears likely, the possibility remains that its development may be delayed by a number of factors: technical difficulties, cost overruns, environmental resistance, etc. While estimates of the availability of uranium ore vary widely, enriched uranium or plutonium requirements can be calculated with considerably more accuracy. In the early 1980s the AEC's uranium-enrichment plants will reach stretched capacity. New gaseous diffusion or centrifuge plants will have to be constructed at great cost to meet the fuel needs of the thermal reactor economy. Beyond the 1980s though, the supply of fissionable fuel will depend critically on the commercial viability of the LMFBR. This paper discusses one technical approach that could help meet the critical fuel need if the LMFBR is delayed and could significantly advance the development of the fusion reactor at the same time. (auth)

30971 (CONF-721111-, pp 249-259) INDUCTIVE ENERGY STORAGE REQUIREMENTS FOR A TOKAMAK FEASIBILITY EXPERIMENT. Rowberg, R. E.; Driga, M. D.; Woodson, H. H. (Univ. of Texas, Austin). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

The increasingly large amounts of pulsed energy required for heating and confinement of present and planned fusion experiments make it necessary to develop the technology of inductive energy storage (IES). Present methods (primarily capacitive) will become too costly and large when the energy requirements are greater than 10 MJ. An IES system to supply the pulsed heating energy for the proposed large, turbulently heated Texas Tokamak is being studied at the University of Texas. The stored energy is inductively coupled into the plasma loop when the current in the primary circuit is interrupted. For this a switch capable of interrupting currents up to 10^5 A, withstanding voltages up to 10^6 V, and having an insulation recovery rate (dV/dt) of 20 to 40 kV/μsec is necessary. A capacitor is placed across the switch to limit dV/dt. The resultant circuit is analyzed with the goal of minimizing the number of switches needed and the energy stored in the dV/dt limiting capacitors. The conductions are set to supply 14 MJ to the plasma within a specified time. This and the resistance of the load are dependent on the necessity to generate the turbulence required to heat the plasma to fusion temperatures. The results of the analysis indicate (1) the most severe duty on the switch is due to dV/dt; (2) with an increase in switch capabilities of about a factor of 2, a reasonable IES system is possible where less than a third of the required heating energy is stored in the limiting capacitors; and (3) a ferromagnetic core is required to reach these conditions. (auth)

30972 (CONF-721111-, pp 260-297) HOMOPOLAR MOTOR-GENERATOR DESIGNS FOR CHEAP INERTIAL ENERGY STORAGE. Rylander, H. G.; Woodson, H. H.; Becker, E. B.; Rowberg, R. (Univ. of Texas, Austin). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Design studies show that homopolar motor-generators with 50 to 3000 MJ of inertial energy storage can be built for a small fraction of the cost of competitive power sources for the large toroidal magnets of the Texas Turbulent Torus. These dc machines operate as a motor to convert electrical energy into stored rotational kinetic energy and then become a generator to provide a large pulse of power for a short time duration. (auth)

30973 (CONF-721111-, pp 298-308) NOVEL HVDC CIRCUIT INTERRUPTER FOR INDUCTIVE ENERGY STORAGE SYSTEMS. Lutz, M. A. (Hughes Research Labs., Malibu, CA). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

As the result of an intensive 7-year program, two high-power switching devices that form the basis of a novel, purely electronic high-voltage dc (HVDC) circuit interrupter have been developed. The first device is a plasma valve, capable of continuous current conduction and possessing voltage recovery and hold-off properties similar to those of a vacuum gap. The second device is an interrupter tube that takes over the current from the plasma valve for a time long enough for the plasma valve to recover its insulating strength and then interrupts the current without the aid of a com-

mutating capacitor. Each of these devices is presently operating at the 100 kV, 1 kA level, and higher ratings are expected. Circuit interrupters based on this technology are expected to find application in inductive energy storage systems for fusion-reactor power conditioning. (auth)

30974 (CONF-721111-, pp 309-321) SWITCHING EQUIPMENT FOR INDUCTIVE ENERGY STORAGE SYSTEMS IN NUCLEAR FUSION RESEARCH. Greenwood, A.; Lee, T. H. (Rensselaer Polytechnic Inst., Troy, NY). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Arresting the flow of direct current in an inductive circuit is a difficult task. It is particularly difficult in fusion-type applications, where the currents are high and a very large number of switching operations must be performed. The traditional approach of a high-arc-energy switching device is unacceptable because its life is much too short and much of the stored energy destined for the experiment must be dissipated in the switch. Two solutions are presented, one involving vacuum-circuit-breaker technology and the other solid-state switching techniques. A specific equipment of the first kind, for 30 kA, 20 kV, is described. The merits and shortcomings of the two approaches are discussed. (auth)

30975 (CONF-721111-, pp 409-425) PERFORMANCE OF A 12-COIL SUPERCONDUCTING BUMPY-TORUS MAGNET FACILITY. Roth, J. R.; Holmes, A. D.; Keller, T. A.; Krawczonek, W. M. (Lewis Research Center, Cleveland). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

The NASA–Lewis "bumpy-torus" facility consists of 12 superconducting coils, each 19 cm in inside diameter and capable of 3.0 teslas on their axes. The coils are equally spaced around a toroidal array with a major diameter of 1.52 m and are mounted with the major axis of the torus vertical in a single vacuum tank 2.6 m in diameter. Final shakedown tests of the facility mapped out its magnetic, cryogenic, vacuum, mechanical, and electrical performance. The facility is now ready for use as a plasma-physics research facility. A maximum magnetic field on the magnetic axis of 3.23 teslas has been held for more than 60 min without a coil normalcy. The design field was 3.00 teslas. The steady-state liquid-helium boil-off rate was 87 liters of liquid helium per hour without the coils charged. The coil array was stable when subjected to an impulsive loading, even with the magnets fully charged. When the coils were charged to a maximum magnetic field of 3.35 teslas, the system was driven normal without damage. (auth)

30976 (CONF-721111-, pp 442-482) FRASCATI TOKAMAK AND PLASMA FOCUS EXPERIMENTS: DESIGN INFORMATION. Toschi, R. (EURATOM-CNEN, Rome). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

At the Laboratorio Gas Ionizzati in Frascati (Italy), the technological activities are concentrated mainly on the construction of the Tokamak and the Plasma Focus facilities. The Tokamak facility includes a liquid-nitrogen-cooled toroidal magnet that produces a field of 100 kG on a major radius of 83 cm and a liquid-nitrogen-cooled air-core transformer that stores a flux of 3.5 V sec. The plasma current is expected to be of the order of 1 MA (at q = 3). Power is supplied by two motor-generator–flywheel–rectifier sets of 120 MW and 150 MJ and 30 MW and 55 MJ for the magnet and the transformer, respectively. The Plasma Focus facility includes a fast condenser bank of 1-MJ stored energy and an experimental chamber with a diameter of the order of 1 m; an output of 10^{13} neutrons/pulse in D–D and a plasma current of 6 MA are expected. (auth)

30977 (CONF-721111-, pp 538-542) BLANKET-COOLING OPTIMIZATION FOR THE PRINCETON FUSION POWER REACTOR. Davison, P. W. (Princeton Univ., NJ). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

A study was made for optimizing the design of the cooling system for the breeding blanket of the Princeton reference design model of a fusion power reactor. The constraints observed were compatibility with the overall design of the reactor, use of conventional structural materials, use of eutectic flibe for breeding, and use of helium for heat transfer. The parameters varied were cooling-tube diameter and/or length, cooling-tube wall thickness, coolant pressure, and heat load per tube in high-heat-flux regions. The results of the study indicate that the most satisfactory parameter for optimization was the cooling-tube diameter, and the optimum value was found to be between 2 and 3 cm outer diameter. The other parameters gave optima at limiting constraints. (auth)

30978 (CONF-721111-, pp 543-554) ENTRY-REGION EFFECTS ON LITHIUM FLOW AND PRESSURE DROP IN FUSION-REACTOR BLANKETS. D'Arcy, G. P.; Schmidt, P. S. (Univ. of Texas, Austin). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

When pumping requirements and pressure losses for liquid-metal flows in fusion-reactor blankets are computed, it is commonly assumed that the flow has reached a fully developed condition. This paper examines the effect of a strong axial magnetic field in suppressing flow development for a conducting fluid in a channel. It is shown that the axial field produces body forces that tend to retard the growth of the viscous wall layers, producing longer entry length and higher pressure-drop coefficients than in nonmagnetic-entry flows or in magnetic fully developed flows. Example calculations are presented for a typical fusion-reactor configuration, and pressure-drop comparisons between fully developed and nonfully developed situations are given. It is shown that, for practical purposes in fusion reactors, the flow never reaches a fully developed condition. Though this fact may have a significant influence on heat transfer, pressure drop in the axial field region is still negligible in comparison with the transverse-field region. Axial-entry effects may affect the transverse pressure drop in a secondary manner, however, by producing a significant change in required coolant flow rate. (auth)

30979 (CONF-721111-, pp 555-583) COOLING OF CONTROLLED THERMONUCLEAR FUSION REACTORS OF TOROIDAL CONFIGURATIONS. Moszynski, J. R.; Petrick, M.; Coultas, T. A. (Univ. of Delaware, Newark). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Heat removal from a controlled thermonuclear reactor (CTR) may be a key factor in the system economics. The coolant choice and coolant-system geometry can affect plant efficiency, environment impact, capital cost of the plant, and structural components. Thus, these factors should be carefully considered in a conceptual CTR design. Previous CTR studies have been made for a particular design and with a particular coolant. This paper makes a more general coolant comparison. Two generic types of coolant geometries are considered for a particular set of conditions, and the wall-loading limits for several coolants are determined. (auth)

30980 (CONF-721111-, pp 584-594) LITHIUM COOLING FOR A LOW-BETA TOKAMAK REACTOR. Sze, D. K.; Stewart, W. E. (Univ. of Wisconsin, Madison). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

A conceptual blanket design, based on lithium coolant, is proposed for a D–T fusion reactor. The reactor is a Tokamak made of 316 stainless steel, with major and minor radii of 12.5 and 2.8 m, respectively. The maximum magnetic field is 86 kG. The nominal wall loading is 0.85 MW/m^2, and the maximum temperature on the first wall is 500°C. The flow configuration is a compromise between power consumption and thermal efficiency. The power required for pumping is moderate, and some power is sacrificed to reduce thermal-feedback problems. The magnetic field is used to control the flow distribution within the blanket. The effects of thermal stress and hoop stress in the first wall are considered. (auth)

30981 (CONF-721111-, pp 595-600) POTENTIAL USE OF GERT IIIz COMPUTER SIMULATION TECHNIQUES IN THE ANALYSIS OF FUNDING STRATEGIES. Vanston, J. H. (Univ. of Texas, Austin). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

It is proposed that the use of probabilistic computer simulation embodying essential scientific, technical, and administrative considerations would assist in developing and monitoring effective funding strategies. Although the development and employment of a meaningful overall fusion power model would be a very extensive project, work is in progress to investigate the appropriateness of the concept. A logic network has been prepared which models in gross terms the development of the toroidal diffuse pinch configuration through the first commercial fusion reactor. Estimates of the probability of completion of essential tasks and of the times to complete those tasks under various funding assumptions have been gathered from knowledgeable people. These estimates have been incorporated into the model using the GERT IIIz program which accommodates probabilistic input, considers partial success of projects, allows revision and retest of successful activities, and permits dynamic modification of the program to consider cross impacts. The program produces estimates of the probability of achievement vs. time to achievement for key milestones in the fusion-reactor program under various funding assumptions. (auth)

30982 (CONF-721111-, pp 668-676) APPLICATION OF FAST BREEDER REACTOR EXPERIENCE TO FUSION-BLANKET STUDIES. Davey, W. G. (Univ. of Texas, Austin). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

The neutronics and photonics aspects of fusion-blanket design differ from those of fast breeder reactors in that (1) the neutrons are of higher energy and are more forwardly directed, (2) the geometry is one of a reactor shield or blanket with no reactivity questions rather than a combined core–blanket geometry, and (3) the relative importance of photons and neutrons is very different owing to the absence of the very energetic fission process. Nevertheless, the basic requirements of both fusion and fast-fission reactors are identical in the broad aspects of the need for (1) neutron and photon cross sections, (2) complex computer codes to utilize these data, and (3) integral experiments to check and if necessary modify the cross sections and calculational techniques. It is therefore not surprising that the majority, or perhaps all, of the techniques needed for fusion-blanket design exist in, or can be developed from, fast breeder reactor techniques. In brief these are the extensions of the Evaluated Nuclear Data File cross-section library, the use of sophisticated many-group Monte Carlo, transport, and diffusion codes, and the experimental measurement of detailed neutron and gamma-ray spectra and key reaction rates in large simulations of the projected systems. The major pertinent techniques now available and probable extensions of these are briefly described and discussed. (auth)

30983 (CONF-721111-, pp 677-702) PRELIMINARY CONCEPTUAL DESIGN OF A TOKOMAK REACTOR. Abdou, M. A.; Boom, R. W.; Carbon, M. W. (Univ. of Wisconsin, Madison). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

A scoping design was carried out to determine the technological problems associated with the low-beta Tokamak approach to reactors. This system is envisioned to operate at quasi-steady state, producing about 1000 MW(th) and using stainless steel and a wall loading of 0.85 MW/m^2. Various system aspects of the design are described, including the plasma and its control; a diverter and startup magnet system; a blanket, shield, and heat-removal system; toroidal magnet design and limiting stress effects; and an analysis of system hazards. (auth)

30984 (CONF-721111-, pp 703-730) MODELING AND OPTIMIZATION OF A CONCEPTUAL THERMONUCLEAR FUSION REACTOR SYSTEM. McCann, R. B.; Powers, E. J. Jr. (Univ. of Texas, Austin). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

This paper demonstrates how computer modeling and optimization techniques can be used to examine the complex interrelations between the engineering and economic aspects of fusion reactors. Data obtained from various published sources have been used to describe the engineering criteria. These data, which are usually the result of lengthy and complex numerical calculations, are then approximated mathematically for use in the model. The cost function depends on the cost and relative amounts of each material used in the reactor. The objective function, which is defined as the cost divided by the useful thermal-power output of the reactor, is minimized subject to a set of constraints, which include linear geometrical constraints and nonlinear engineering constraints. The optimization is accomplished by using the Sequential Unconstrained Minimization Technique (SUMT) on a CDC 6600 computer. The results from this technique and from parameter-variation studies are presented. The inclusion of economic considerations leads to some interesting results in that the engineering implications of a particular situation are often straightforward, but the economic considerations often give rise to a much more complex and meaningful problem. (auth)

30985 (CONF-721111-, pp 766-782) POTENTIAL MERITS OF CIRCULATING HELIUM-3 IN A D–D FUSION REACTOR BLANKET. Owen, D. L.; Impink, A. J. Jr. (Carnegie–Mellon Univ., Pittsburgh). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

The alterations in current concepts of D–D fusion machines which would result from the incorporation of a ^{3}He–^{4}He region in the blanket are discussed. Using the ^{3}He(n,p)^{3}H reaction to separate the ^{3}He and the ^{4}He, which have been removed from the plasma, results in negligible losses in power production. A region of mixed ^{3}He and ^{4}He inside the coils also provides thermal and neutron shielding. Channels of ^{3}He–^{4}He in the graphite moderator would be the coolant for the system. (auth)

30986 (CONF-721111-, pp 801-811) NECESSARY CONDITIONS FOR STEADY-STATE OPERATION OF CONTROLLED FUSION EXPERIMENTS. Roth, J. R. (Lewis Research Center, Cleveland). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Considering only the characteristic instability frequencies and growth rates of a plasma, it is usually concluded that a plasma reaches a steady state in less than 1 sec. However, steady-state plasma-physics experiments have shown that plasma–wall interactions can increase the background pressure by more than an order of magnitude and that minutes or hours are required to establish an equilibrium. Physical arguments are used to show that plasma–wall equilibration times are from several seconds to several minutes for conditions that may exist in controlled fusion experiments. To achieve steady-state experimental conditions, we must either get the experiment over before wall contaminants can reach the plasma, as in theta pinches, or operate the plasma long enough to achieve a detailed balance between wall bombardment and outgassing due to this bombardment. (auth)

30987 (CONF-721111-, pp 831-841) FUSION ENGINEERING AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Kemp, E. L. (Los Alamos Scientific Lab., NM). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

The ZT-1 toroidal z-pinch experiment at Los Alamos uses a 500-kJ capacitor bank to charge a storage inductor through four exploding foil fuses. At near-maximum current the four fuses open and transfer a high-voltage (60 kV) and a fast-rising current into the primary of the ZT-1 experiment. The plasma, which makes up the secondary of the circuit, is shock heated to about 1 keV and is contained for several microseconds when the primary current is crowbarred. An implosion-heating experiment is being built to investigate the heating of theta-pinch plasmas with fast-rising magnetic fields. This experiment will use 125-kV capacitors in a peaking capacitor circuit except that the capacitors are switched into the load at maximum current time rather than at the usual maximum voltage time. The load coil will be driven at four places; so there will be a total of 500 kV around the circuit. A cryogenic, inductive energy-storage system is being developed to power future theta-pinch experiments. The system uses a NbTi superconducting storage coil and a NbTi superconducting switch. When the superconducting switch is driven normal by a fast-cur-

rent pulse, energy from the storage coil is transferred into the load. A 30-kJ experiment is operating, and a 300-kJ experiment is being built. A 6-MJ system is also being studied. (auth)

30988 (CONF-721111-, pp 918-930) FUSION–FISSION HYBRIDS: A SUBCRITICAL THERMAL FISSION LATTICE FOR A D–T FUSION REACTOR. Leonard, B. R. Jr.; Wolkenhauer, W. C. (Battelle Memorial Inst., Richland, WA). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

A blanket for a D–T thermonuclear plasma which contains fissile material offers the opportunity for multiplication of the D–T source neutron strength and increased thermal energy through the use of fission energy. A particular type of such fusion–fission hybrid system was studied in which the fissile blanket is essentially a nuclearly subcritical thermal fission-reactor lattice. The thermal fission lattice was a graphite-moderated helium-cooled lattice whose initial fuel was natural or slightly enriched uranium. The results of this study indicate that this type of hybrid exhibits a high potential for a viable power plant while utilizing plasma characteristics that are an order of magnitude or more less stringent than the break-even conditions for a pure fusion reactor. The potential benefit of the hybrid system is the ability to use fission energy in a subcritical reactor at a time when D–T plasma characteristics do not yet allow a viable power plant in a nonhybrid device. The results of this study indicate another benefit in the potential for full utilization of the fissile and fertile energy reserves in hybrid systems. (auth)

30989 (CONF-721111-, pp 931-943) NEUTRON AND GAMMA HEATING RATES IN FUSION-REACTOR BLANKETS. Perry, R. T. Jr.; Davidson, J. N.; Koehler, W. H. (Texas A and M Univ., College Station). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Spatially dependent neutron and gamma fluxes and their associated heating rates are calculated for two separate breeding blankets of a conceptual fusion reactor. Both designs incorporate liquid lithium as the major coolant, but one is constructed of niobium and the other is constructed of stainless steel with some liquid-sodium coolant. All flux calculations were performed with a modified version of the transport code, DTF-IV. Calculations involving various energy-group structures and degrees of anisotropy are compared. (auth)

30990 (CONF-721111-, pp 944-963) CALCULATION OF FUSION SPECTRUM IN GRAPHITE. Freim, J. B.; Draper, E. L. Jr. (Pacific Northwest Labs., Richland, WA). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

Two codes, ANISN, a discrete-ordinates code, and BMC, a Battelle Monte Carlo code, are used to predict reaction rates of selected reactions in a graphite mock-up of a fusion blanket. A parametric study done using ANISN shows that calculated activities for threshold reactions decrease at position 0 when the mesh size is decreased from 1 to $^1/_4$ in. The threshold and thermal reactions both increase when the quadrature order is increased from S_8 to S_{16}. A comparison of the codes shows that ANISN slab and BMC agree well for the threshold reactions. ANISN slab and ANISN sphere do not agree for thermal reactions; however, ANISN slab has the correct shape. (auth)

30991 (CONF-721111-, pp 993-1008) ELEVATED-TEMPERATURE FATIGUE CHARACTERISTICS OF HELIUM-IMPLANTED STAINLESS STEEL. Serpan, C. Z. Jr.; Smith, H. H.; Smidt, F. A.; Pieper, A. G. (Naval Research Lab., Washington, DC). Apr 1974.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

In technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors.

The effect of helium gas on the fatigue characteristics of annealed and 20% cold-worked 316 stainless steel was evaluated at 816°C (1500°F). Notched thin-sheet fatigue specimens were implanted to depths of 0.1 and 0.2 mm (0.004 and 0.008 in.) with 10^{-5} atom fraction helium in the Naval Research Laboratory cyclotron. One cold-worked specimen was implanted with 10^{-4} atom fraction helium. The annealed 316 stainless steel showed increased crack growth rate in the presence of helium, but increasing amounts of helium in the cold-worked 316 stainless steel caused a decreasing rate of crack growth. No change was observed in crack growth rate as the crack moved from a region of implanted helium into an unimplanted region; furthermore, the fracture surfaces did not exhibit any consistent difference in fracture mode for the implanted vs. unimplanted regions. Transmission-electron-microscopy (TEM) examinations revealed the presence of helium bubbles of about 50 Å diameter in grain boundaries and along dislocations in both the annealed and cold-worked material. The helium bubble-dislocation interactions appear to be strengthening the cold-worked material, thus accounting for the increased life and decreased crack growth rate; the same interaction occurs in the annealed material, but the effects are reversed. Coordinated fractographic and TEM examinations as well as change-of-strain-rate tension tests on materials duplicating those in this study will be needed to help explain the differences in fatigue response of annealed and cold-worked 316 stainless steel and the effects of implanted helium. (auth)

30992 (CONF-730315-) PROCEEDINGS OF THE THIRD INTERNATIONAL SYMPOSIUM ON TOROIDAL PLASMA CONFINEMENT HELD IN GARCHING, GERMANY 26–30 MARCH 1973. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). [nd]. 117p.

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Separate abstracts were prepared for 43 of the included papers. Abstracts for the remaining 42 papers appeared previously in NSA. (MOW)

For abstracts of individual papers see: 30887–30904, 30927–30929, 30942–30947, and 30993–31008.

30993 (CONF-730315-, pp vp. Sect. A1-I) SURVEY OF AXISYMMETRIC TOROIDAL PINCH EXPERIMENTS. Waelbroeck, F. (Kernforschungsanlage, Juelich, Ger.). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Several axisymmetric toroidal pinch confinement schemes are being studied. A discussion of the main differences between these approaches, and a short summary of results achieved before this meeting are presented. (auth)

30994 (CONF-730315-, pp vp. Sect A2-I) HIGH-BETA STELLARATOR EXPERIMENTS. Kaufmann, M. (Max- Planck-Institut fuer Plasmaphysik, Garching, Ger.). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Experiments on the "high-beta stellarator" and their theoretical interpretation are reviewed. After a recapitulation of the origins of this work, the theoretical basis is summarized. This is followed by a presentation of the experiments on linear devices regarding the establishment of helical equilibria and their stability. Results of toroidal sector experiments conducted at Los Alamos and Garching and now first results of a complete torus ISAR T 1 at Garching is reported. A short look at experiments of the next generation is also included. (MOW)

30995 (CONF-730315-, pp vp. Sect A4) DIFFUSION AND STABILITY IN PINCH DISCHARGES. Crow, J. E.; Robinson, D. C. (Culham Lab., Abingdon, Eng.). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The effects of field, particle and thermal diffusion on the central regions of an initially MHD stable reversed field configuration were studied analytically with the result that the requirements of stability and diffusion together necessitate a higher shear and lower β_0 than MHD stability alone. (auth)

30996 (CONF-730315-, pp vp. Sect A6) MEASUREMENTS OF THE FIELD DIFFUSION IN AN AXISYMMETRIC PLASMA TORUS WITH NONCIRCULAR CROSS SECTION. Plantikow, U.; Schlueter, J. (Kernforschungsanlage, Juelich, Ger.). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The voltage applied to the TESI experiment has been increased without changing the experimental geometry. The penetration time of the toroidal magnetic field was thereby increased by a factor of three to four and the decay time of the toroidal current was lengthened, implying higher plasma temperatures. (auth)

30997 (CONF-730315-, pp vp. Sect. A9) PROGRAMMING AND USE OF TRANSVERSE FIELDS AND CONTROL OF THE PLASMA CURRENT IN TEE. Sand, F.; Belitz, H. J.; Geissler, E.; Korten, M.; Noll, P.; Waelbroeck, F.; Waidmann, G. (Kernforschungsanlage, Juelich, Ger.). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

In the fast high-β Tokamak-like experiment TEE the plasma current and the vertical field were controllable during about 200 μsec by a first type of power crowbar using passive circuitry. A later control should then be possible by low voltage power crowbar techniques. (auth)

30998 (CONF-730315-, pp vp. Sect B4) TOKAMAK EXPERIMENT AT JAERI. Itoh, S.; Fujisawa, N.; Funahashi, F. (Japan Atomic Energy Research Inst., Tokai). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

In the recent experiment JFT-2 (the JAERI Tokamak), the maximum plasma current of 175 kA corresponding to q = 2 was attained. The scaling law of energy confinement time of $\tau_E \propto a^2 B_p$ confirmed for such a large plasma radius as 25 cm. The preliminary experiment of the dynamic limiters is being carried out. (auth)

30999 (CONF-730315-, pp vp. Sect. B5) FINGER-RING TOKAMAK. Bortnikov, A. V.; Balborodov, Yu. T.; Brevnov, N. N. (Inst. of Atomic Energy, Moscow). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The main design features of a finger-ring tokamak are described. The cross section of the working volume has the form of a segment. Some experimental results showing the discharge current and voltage traces are given. (MOW)

31000 (CONF-730315-, pp vp. Sect B11-I) SLOW TOROIDAL THETA-Z PINCH. Morton, A. H. (Australian National Univ., Canberra). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1873).

A brief description of the device used for the slow toroidal θ-z pinch experiments is given and aspects of the plasma behavior are discussed, including variation, during the instability cycle, of the safety parameter, q(r), where this quantity has been obtained from magnetic field measurements within the plasma. An outline is given of a method used to determine surfaces to which runaway electron motion is constrained. (auth)

31001 (CONF-730315-, pp vp. Sect. B16-I) CLEO TOKAMAK EXPERIMENT. Gibson, A.; Bickerton, R. J.; Cole, H. C. (Culham Lab., Abingdon, Eng.). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Tokamak discharges were established without using a thick conducting shell. Currents up to 70 kA and gross stability for up to 80 msec are obtained. No obvious instability or loss is produced when a 48 kW neutral beam is injected tangentially into the plasma. (auth)

31002 (CONF-730315-, pp vp. Sect. B18) PLASMA OPERATION OF ALCATOR AT LOW MAGNETIC FIELDS. Ascoli-Bartoli, U.; Blanken, R.; Brossier, P. (Massachusetts Inst. of Tech., Cambridge). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The motivation of the Alcator experiment is to produce and heat toroidal plasmas with high currents and high current densities. Initial plasma operation has been achieved with plasma currents up to 50 kA, limiter radius of 10 cm and toroidal magnetic fields of about 10 kG. The ratio of plasma radius to the copper shell radius is about 0.8. The major radius is 54 cm. A brief discussion of machine operation is given. (MOW)

31003 (CONF 730315-, pp vp. Sect. B20) CONTROL OF THE PLASMA CURRENT AND PLASMA POSITION IN TFR. Cotsaftis, M.; Dei-Cas, R.; Dudon, F.; Ginot, P.; Huguet, M.; Rebut, P. H. (CEN, Fontenay-aux-Roses, France). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

In the TFR experiment the pulse duration of the plasma current is expected to reach 0.5s. This is much longer than the resistive penetration time of the copper shell and a feed back system must be used to control the plasma position. (auth)

31004 (CONF-730315-, pp vp. Sect. B24) HIGH POWER HIGH EFFICIENCY ION SOURCE. Aldcroft, D.; Burcham, J.; Cole, H. C.; Cowlin, M.; Sheffield, J.; Speth, E. (Culham Lab., Abingdon, Eng.). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The results of initial tests of the injection system on the CLEO Tokamak are described. The injector utilizes a new design of plasma source, and beam powers of up to 250 kW (65% H_3^+, 20% H_2^+, 15% H_1^+) 8.5 A at 30 keV, have been obtained on test. The electrical efficiency is ~ 85% and the gas efficiency > 40%. Experiments to date show that the neutral beam power which reaches the CLEO plasma represents 33% of the total power in the ion beam. Neutral beam powers of ~ 50 kW have been injected, and measurements on a calorimeter facing the injector indicate that most of the injected beam is ionized in the plasma. (auth)

31005 (CONF-730315-, pp vp. Sect. D2-I) SURVEY OF STELLARATOR EXPERIMENTS IN JAPAN. Miyamoto, K. (Nagoya Univ., Japan). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Experiments of plasma confinement and heating in the toroidal field of stellarator or torsation type are being carried out in 3 devices in Japan. The J.I.P.P. stellarator is a circular l = 3 stellarator with the major radius of 50 cm with eight field periods. The minor radius of helical coil is 10.4 cm and the inner radius of the vacuum vessel is 8.4 cm. The stationary (5 sec.) toroidal field is 4 KG at maximum, the angle of rotational transform angle ι is up to 1.7. SPAC-I has a magnetic field of l = 2 torsatron type without toroidal coils. The number of the field periods is 21 so as to make the toroidal coils unnecessary, combined with an appropriate vertical field. The major radius is 40 cm with maximum toroidal field of 1.8 KG. Heliotron D has a magnetic field of l = 2 torsatron type with field periods of m = 25. A current carrying helical conductor of minor radius 13 cm is suspended inside a vacuum vessel with inner radius 30 cm. The major radius is 108.5 cm and the toroidal coils are excited up to 5 KG with flat top of 25 ms by condenser discharge. Because of helical winding with short pitch and large aspect ratio, the rotational transform angle and the shear parameter can be large ($\iota/2 \simeq 1.5-5, \Theta \simeq 0.2-2$). A brief discussion of each is presented. (MOW)

31006 (CONF-730315-, pp vp. Sect. G1) SCALING OF TOKAMAKS. Engelmann, F.; Enriques, L. (EURATOM-CNEN, Frascati, Italy). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

0D and 1D Tokamak codes have been used in the past for evaluating the performance for specific machine parameters. The scaling of the performance as following from a dimensional analysis of the neoclassical and "extended-plateau" models is discussed. Numerically derived quantitative results are given. (auth)

31007 (CONF-730315-, pp vp. Sect. G3) FUTURE TOROIDAL PINCH EXPERIMENTS. Bodin, H. A. B.; James, T. E.; Newton, A. A.; Robinson, D. C. (Culham Lab., Abingdon, Eng.). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

A review is given of previous work, pointing out its limitations and indicating the objectives of new experiments and the required parameters. The expected plasma behavior in such experiments is discussed. (auth)

31008 (CONF-730315-, pp vp. Sect. G4) WENDELSTEIN VII PROJECT. Blaumoser, M.; Duesing, G.; Elsner, A. (CEN, Fontenay-aux-Roses, France). [nd].

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Some engineering parameters of the W VII stellarator are discussed. The scientific aims of the experiment are described. (MOW)

31009 (IPP-2-218) EFFECT OF PERTURBATIONS ON THE MAGNETIC FIELD OF THE W VII-STELLARATOR. Rehker, S.; Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jan 1974. 38p. Dep. NTIS (U. S. Sales Only) $5.00.

Due to imperfections of the coil system, different perturbation fields occur which modify the unperturbed magnetic field of the W VII-Stellarator. The structure of islands, caused by these perturbations was investigated numerically. These islands exist on resonant surfaces with $\iota = 1/2, 1/3, 1/4 \ldots$. The width of the islands scales with the square root of the perturbation field, typical values are between 3 and 10 cm. If the coil system can be built with an accuracy of 0.1 cm, the width of the islands can be reduced to a tolerable level, but the islands cannot be avoided completely. (auth)

31010 (LA-UR-74-280) PHYSICS PROBLEMS OF THERMONUCLEAR REACTORS. Ribe, F. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 20p. (CONF-731142-1). Dep. NTIS $3.00.

From topical conference on energy; Philadelphia, Pennsylvania, USA (Nov 1973).

A problem common to all controlled fusion reactors is that of the burning deuterium–tritium fuel under conditions of plasma confinement which approach the ideal limit as nearly as possible. After ignition, the balance between alpha-particle energy deposition and plasma losses (radiation plus thermal and particle diffusion) determines the stability or instability of the burn in toroidal systems. Tokamak systems are described both with unstable, injection-regulated burn cycles and stabilized steady-state burn conditions. In the theta-pinch reactor an unstable burn occurs, somewhat regulated by high-beta plasma expansion, which is quenched by a programmed plasma decompression. The plasma expansion during the constant-pressure burn provides "direct" conversion of plasma thermonuclear heat to electrical output, in addition to the electrical power derived from the neutron energy through conventional thermal conversion equipment. The open-ended mirror reactor is characterized by a direct conversion system for recovering end-loss plasma energy and converting it to electrical energy for reinjection into the plasma. This allows a favorable reactor energy balance and an amplification factor Q (= thermonuclear energy output/injected plasma energy) which is compatible with classical collisional losses. For the three reactor types considered the ramifications of burn and confinement conditions for reactor configuration, energy balance, economy, fuel handling, materials problems, and environmental-radiological factors are considered. (auth)

31011 (MATT-1006) ACTIVATION AND AFTERHEAT IN A FUSION POWER REACTOR. Price, W. G. Jr. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Oct 1973. Contract AT(11-1)-3073. 21p. Dep. NTIS $4.25.

A series of calculations was performed to analyze the activation of the structure of the Princeton Reference Design D–T Fusion Power Reactor. The relevant isotope transmutation chains were solved numerically for 30 years' operation (¾ load factor) at 5310 MW(t). Decay heat and activity curves versus time after shutdown were obtained for the reference stainless steel structure and for a vanadium alloy as an alternate. Afterheat appears not to pose a safety hazard because of the large blanket heat capacity; however, the large amount of cobalt-60 produced in the steel (2.82×10^7 curies) may make the ultimate disposal of that material difficult. Although the activation in the vanadium is comparable to that in the steel, the short half-lives of the radioisotopes (less than a year) greatly reduce the disposal problems. (auth)

31012 (UCRL-74943) REVIEW OF 2XIIB PROJECT. Anderson, C. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.) 20 Aug 1973. 12p. (CONF-731114-52). Dep. NTIS $3.00.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A review is given of the 2X project, including project history and recent results, with the intent that both those new to controlled thermonuclear research engineering and those people familiar with its progress will benefit. The current 2XII program plan is reviewed, with emphasis on the major device fabrication underway at the present time. This construction consists primarily of a new magnet for 2XII, and has been designated 2XIIB. The injection of a 600A neutral beam is described. The final portion of the paper is a progress report and a summary of cost estimates and scheduling. (MOW)

31013 (UCRL-75547) DESIGN STUDY OF A NEUTRAL INJECTION SYSTEM FOR THE FUSION ENGINEERING RESEARCH FACILITY (FERF). Hamilton, G. W.; Dexter, W. L.; Smith, B. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Mar 1974. 22p. (CONF-740402-4). Dep. NTIS $4.25.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The first stage of a design study of a 500-A, 65- to 100-keV injection system for a mirror-type fusion test reactor using converging beams of D and T atoms continuously injected into an open-ended Yin–Yang magnetic field is described. Positive ions (D^+ and T^+) were chosen for the primary beam because of the reasonably high neutralization efficiency (68%). Beam power densities will be limited to about 4 kW/cm^2 because of electrode heating and the dimensions required to avoid high-voltage breakdowns in the three-stage, multiple-aperture accelerator. A plasma-source module suitable for these requirements consists of an arc chamber with thermionic filaments designed for 4,000-hr lifetimes and with three 2- × 35-cm gridded extraction areas. Beam neutralization is accomplished by charge exchange in the D_2 and T_2 gas flowing from the source modules through ducts of the appropriate pressure and dimensions. After neutralization the background pressure will be reduced to 3×10^{-5} torr by a two-stage differential pumping system, and the neutral beam density will be increased by a factor of 30 by convergence upon the reactor entrance. Problems relevant to fusion reactors, such as tritium handling, neutron activation, etc., have been considered in connection with the injector design. (auth)

31014 MAGNETIC SURFACES OF STELLARATOR FIELD WITH A CURRENT-CARRYING PLASMA. Miyamoto, K. (Nagoya Univ., Japan); Inoue, N. J. Phys. Soc. Jap.; 35: No. 6, 1973(Dec 1973).

31015 EFFECTS OF DIAPHRAGM ON THE CURRENT DISTRIBUTION AND STABILITY IN THE SCREW-PINCH DISCHARGE. Hayase, K.; Okuda, T. (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 12: No. 12, 1948-1949(Dec 1973).

31016 POWERFUL INJECTOR OF NEUTRALS WITH A SURFACE-PLASMA SOURCE OF NEGATIVE IONS. Belchenko, Yu. I.; Dimov, G. I.; Dudnikov, V. G. (Nuclear Physics, Novosibirsk, USSR). Nucl. Fusion; 14: No. 1, 113-114(Jan 1974).

The operation of surface plasma sources for negative ion beams is described. A diagram shows the dependence of the H^- current density inside the emission slit on the discharge current under optimized conditions with a plasma layer thickness of 0.5 mm. Various parameters of the source are discussed. (MOW)

31017 D–T-PLASMA AS A SOURCE OF NEUTRONS FOR THE COMBUSTION OF ^{238}U. Kolesnichenko, Ya. I.; Reznik, S. N. . (Nuclear Research Inst., Kiev). Nucl. Fusion; 14: No. 1, 114-116 (Jan 1974).

A hybrid reactor for the burning of ^{238}U is discussed. The device consists of two breeding blankets. One for tritium breeding and the other for ^{239}Pu production. Energy calculations for the system are described. (MOW)

31018 NUCLEAR PERFORMANCE OF VANADIUM AS A STRUCTURAL MATERIAL IN FUSION REACTOR BLANKETS. Steiner, D. (Oak Ridge National Lab., TN). Nucl. Fusion; 14: No. 1, 33-44(Jan 1974).

The nuclear performance of vanadium as a structural material in a deuterium–tritium fusion reactor is discussed. For comparison, calculations are also presented for niobium. The areas considered include: (1) tritium breeding; (2) nuclear heating; (3) radiation effects relating to material damage; and (4) neutron-induced activity. It is concluded that: (1) the tritium breeding characteristics of vanadium are somewhat superior to those of niobium; (2) nuclear heating in the first wall of the blanket will be substantially lower with vanadium than with niobium; (3) helium and hydrogen production in the first wall will be significantly greater with vanadium than with niobium; and (4) vanadium will exhibit an afterheat and biological hazard several orders of magnitude lower than that of niobium for times-after-shutdown of ~100 days and greater. (auth)

31019 TORUS TYPE THERMONUCLEAR APPARATUS. Kazawa, Y.; Wase, K. (to Hitachi Ltd.). Japanese Patent 1973,3279. 13 Jun 1969. 3p. (In Japanese).

A magnet coil for plasma confinement arranged in a torus type thermonuclear apparatus has a simple structure and employs insulating oil for both insulation and cooling. A torus-shaped sheath receives a wire wound by a number of turns. A pipe for conducting the cooling oil is disposed along the outer periphery of the sheath. A cooling oil inlet is provided in the pipe and in the vicinity of a power supply portion for feeding power to the wire. An inflow port communicating with the interior of the sheath is provided at that part of the pipe which is angularly spaced by 180° from the cooling oil inlet. Ceramic spacers each having a plurality of oil ports are disposed in the sheath so as to support the wire turns with predetermined spacings. An oil discharge port is provided in proximity to the power supply portion. The cooling oil entering at the inlet is branched into two flows, which pass through the interior of the pipe to turn by 180°, respectively. The flows of the cooling oil enter through the inflow port into the interior of the sheath, and turn in the opposite directions, respectively. Then, they are discharged from the oil discharge port. (JA)

31020 FUSION ENERGY. The Stars Have Shown the Way. Thorstensen, B. (Kungliga Tekniska Hoegskolan, Stockholm). Tek. Ukebl.; 121: No. 7, 32-36(14 Feb 1974). (In Norwegian).

A brief discussion of the fusion reactions on which a thermonuclear reactor could be based is followed by a description of the plasma state. Magnetic bottles for containing hot plasmas are then discussed and tokamak devices and magnetic mirrors briefly described. A brief treatment of plasma production and laser fusion is followed by consideration of radiation problems from a fusion reactor, illustrated by a reactor based on the "inner wing" system. Operational reliability is then discussed and finally the future prospects briefly evaluated. (NO)

31021 TOROIDAL SOLENOIDS WITH A SPACE MAGNETIC AND A PLANE-GEOMETRY AXIS. Georgievskii, A. A.; Ziser,

V. E.; Nemov, V. V.; Peletminskaya, V. G.; Pogozhev, D. P.; Sergeev, U. F.; Skoblik, M. N.; Shishkin, A. A. (Physical-Technical Inst., Kharkov). Nucl. Fusion; 14: No. 1, 79-85(Jan 1974).

A study is made of the magnetic field of a solenoid formed by current-carrying loops, the plane of which is perpendicular to a helical line. Analytical expressions are derived for the scalar potential and the components of the magnetic field strength inside a straight solenoid with a dense winding. The toroidal case was investigated using a BESM-6 computer. The results are presented of an experimental study of the magnetic field of a rectilinear system with a helical magnetic axis. The possible design of a toroidal trap with the magnetic configuration in question is discussed. (auth)

31022 MAGNETIC SYSTEMS OF THE STELLARATOR TYPE IN THE PRESENCE OF A SOLENOID WITH A HELICAL MAGNETIC AXIS. Georgievskii, A. V.; Ziser, V. E.; Miranskii, M. A.; Nemov, V. V.; Skoblok, M. N.; Shishkin, A. A. (Physical-Technical Inst., Kharkov). Nucl. Fusion; 14: No. 1, 87-91(Jan 1974).

An investigation is made of a magnetic configuration formed by a combination of fields from a solenoid with a helical magnetic axis and a plane-geometry axis and stellarator helical conductors. Analytical expressions for the determination of the characteristics of the magnetic configuration, examples of magnetic surfaces of the system in a rectilinear approximation, and the results of a numerical calculation of a toroidal variant of the configuration are presented. (auth)

31023 ACCELERATION OF A PLASMA BY AN EXTERNAL AZIMUTHAL MAGNETIC FIELD. Denisov, Yu. N.; Kulandin, A. A.; Kirilkin, V. S. Magn. Gidrodin.; No. 3, 59-62(1973). (In Russian).

By the use of an external magnetic field it is possible to improve significantly the flow characteristics in plasma accelerators. The use of an azimuthal field of an external magnetic system may be one of the ways of improving the parameters of axisymmetrical plasma accelerators (for example, of the coaxial or end type). It is assumed that the plasma is completely ionized, rarified, quasineutral with ions and electrons being magnetized. The theoretical efficiency of the accelerator is determined. It is concluded that a comparatively high operating efficiency is attained in an accelerator having an azimuthal magnetic field in which acceleration of the plasma is achieved by the interaction of radial currents with the external azimuthal field. Smaller fields are possible as compared with the fields in a Hall accelerator. (SJR)

Wave Phenomena

31024 LOWER HYBRID RESONANCE AT LOW COLLISION FREQUENCIES. Glomski, G.; Heinrich, B.; Schlueter, H. (Ruhr Univ., Bochum, Ger.). Phys. Lett., 47A: No. 1, 25-26 (25 Feb 1974).

For low collision frequencies the power transfer to a plasma in the domain of the lower hybrid resonance is measured under linear conditions. Geometrical resonances due to radial eigenmodes are observed to be strongly suppressed as compared to theoretical expectations. (auth)

31025 WAVE PROPAGATION IN A STRATIFIED TURBULENT MAGNETIZED PLASMA. II. Sharma, S. C.; Verma, J. S. (BITS, Pilani, India). J. Inst. Telecommun. Eng.; 18: No. 8, 374-381(1972).

The propagation of a wave across the magnetized field in the turbulent plasma was studied. The modification of the index of refraction due to turbulence is shown. (Indian Sci. Abstr.)

31026 KINETICS OF IONIZATION WAVES. Yakovlev, M. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 547-552 (1973). (In Russian).

The behavior of weakly ionized positive column plasma after disturbances with harmonic and momentum characteristics was studied. The explicit form was found and the phase displacements of the exciting wave were determined. A comparison was made of the results with experimental data. (tr-auth)

31027 THEORY OF SUBHARMONIC EXCITATION IN BOUNDED PLASMAS. Demokan, O. (Middle East Technical Univ., Ankara). J. Phys. Soc. Jap.; 35: No. 3, 892-896(Sep 1973).

The theory of the excitation of one-half and one-third subharmonic of an external signal in a bounded plasma is presented. The discussion to the Tonks-Dattner resonances is particularized. The power and the frequency of the subharmonics as a function of incident power are derived. (auth)

31028 NONLINEAR WAVE PROPAGATION OF CYCLOTRON WAVES IN COLLISIONLESS PLASMAS. Suzuki, T. (Nihon Univ., Tokyo); Ichikawa, Y. H. Progr. Theor. Phys. (Kyoto); 50: No. 5, 814-829(Nov 1973).

A three-dimensional nonlinear Schroedinger equation is derived for cyclotron waves propagating along an external magnetic field in collisionless plasmas on the basis of the Karpman–Krushkal theory of quasi-monochromatic wave propagation in nonlinear-dispersive media. The local-nonlinear coefficient agrees with the one obtained by Kako for the cold plasma, while the nonlocal-nonlinear coefficient is calculated explicitly by taking into account contributions of the resonant particles having the group velocity of the wave. (auth)

31029 NONLINEAR SATURATION AND HARMONIC GENERATION OF AN ELECTRON PLASMA WAVE. Mojri, H. (Tokyo Univ.). J. Phys. Soc. Jap.; 35: No. 2, 592-599(Aug 1973).

The spatial growing plasma wave excited by an electron beam was studied. The gradual change of the dispersion roots from the cold beam type to the hot beam type was observed and it was in good agreement with the theoretical prediction by O'Neil and Malmberg. The nonlinear saturation mechanism of the growing plasma wave was also interpreted by the change of the dispersion roots which was caused by the feedback effect of the wave on the beam particles. Hence, the harmonic spectrum near onset of the saturation did not show the power spectrum of ω^{-5} or $\omega^{-2.5}$. The termination of the saturation level of the unstable plasma wave was observed for the case of the high beam current, but the mechanism is not clear. (auth)

31030 PHYSICAL PICTURE FOR THE ANOMALOUS PROPAGATION OF AN ORDINARY WAVE IN A MAGNETOPLASMA. Ishida, A. (Hiroshima Univ.). J. Phys. Soc. Jap.; 35: No. 4, 1196-1201(Oct 1973).

The physical picture for the anomalous propagation of an ordinary wave at frequency near but below the electron cyclotron frequency is discussed on the basis of the single-electron equation of motion in the magnetostatic and the wave fields. It is shown that the anomalous propagation originates from the forces along and across the magnetostatic field. The perpendicular force deflects the electrons and gives the density perturbation which contributes to the anomalous propagation, as shown by Fried. It is found, however, that the parallel forces connected with the gyration of the unperturbed motion also contribute to the anomalous propagation and accompany no density perturbation. (auth)

31031 MODIFICATION OF WEAK TURBULENCE THEORY DUE TO PERTURBED ORBIT EFFECTS. 2. Nonlinear Landau Damping of Electron Plasma Waves. Mima, K. (Kyoto Univ.). J. Phys. Soc. Jap.; 35: No. 1, 261-271(Jul 1973).

The wave kinetic equation derived in an earlier paper (J. Phys. Soc. Japan 34 (1972) 1620) is applied to the investigation of the effect of finite resonance width on the nonlinear Landau damping of electron plasma waves on electrons. When the resonance width is produced by low phase-velocity waves or ion-waves, the nonlinear Landau damping is strongly modified in two respects. First, its rate is enhanced even if the total energy of the low phase-velocity waves is relatively small (of order 8×10^{-3} times the electron thermal energy for the case of an isotropic spectrum of these waves). Secondly, the Manley-Rowe relation or the conservation of the total plasmon number is violated and as a result, an efficient dissipation of the electron plasma wave energy into the electron thermal energy is obtained. (auth)

31032 NONLINEAR WAVE MODULATION IN A MAGNETIZED COLLISIONLESS PLASMA. Kako, M. (Nagoya Univ., Japan); Furutani, Y.; Ichikawa, Y. H.; Taniuti, T. J. Phys. Soc. Jap.; 35: No. 5, 1526-1532(Nov 1973).

Nonlinear modulation of quasi-monochromatic electromagnetic waves propagating parallel to an external magnetic field was investigated with particular attention to contributions of resonant particles at the group velocity. The contributions of these resonant particles give rise to a nonlocal–nonlinear term and modify the local-nonlinear term of the nonlinear Schroedinger equation. An explicit expression of a coefficient of the nonlocal–nonlinear term is given for a plasma characterized by isotropic Maxwellian velocity distribution functions. In a vanishing temperature limit this coefficient becomes zero and the nonlinear Schroedinger equation agrees with that obtained by using a fluid model. (auth)

31033 NONLINEAR INTERACTIONS OF PLASMA WAVES IN THE PRESENCE OF ELECTRON BEAMS. Pal, J.; Srivastava, K. M. (Univ. of Jodhpur, India). Nuovo Cim.; 20B: No. 1, 9-24 (11 Mar 1974).

The quasi-linear development of plasma waves in the presence of a strong uniform magnetic field and the electron beams which can cause dc drifts of both species together are studied. A standing wave in an inhomogeneous plasma leads to stratified drift patterns which can convect plasma out either directly or through secondary effects. It is found that these drifts increase in the

presence of electron beams. For detailed treatment, extraordinary electromagnetic waves and ion cyclotron waves are used in the analysis. (auth)

31034 INVESTIGATION OF LARGE AMPLITUDE OSCILLATIONS IN AN INHOMOGENEOUS PLASMA NEAR ION CYCLOTRON RESONANCE. Grigor'eva, L. I.; Smerdov, B. I.; Sapogov, S. A.; Chechkin, V. V. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 66: No. 2, 598-610(Feb 1974). (In Russian).

Excitation of large amplitude oscillations at a frequency $\omega \sim \omega_{Hi}$ in a radially inhomogeneous plasma produced by a high-current linear discharge in hydrogen is investigated experimentally. The plasma density at the axis was of the order of several units 10^{14} cm^{-3}. The oscillations were generated by a Stix coil which was the inductance of a shock excited circuit with stored energy up to 7 J and a frequency of 6.6 Mc. The spectrum of the oscillations excited in the plasma is investigated. An excitation resonance is observed at $\omega \approx \omega_{Hi}$. The radial distribution of the hf field in the plasma is studied and the type of the excited oscillations is determined. A sharp increase of the hf field strength in the resonant layer for which $n_{\parallel}^2 \approx \epsilon_1$ is observed. At excitation resonance up to 70% of the energy stored in the circuit was transferred to the plasma. The hf field amplitude in the plasma reached 500 Oe and a rapid (during a time $\sim 2\pi/\omega$) increase of the transverse plasma energy by 7×10^{12} eV/cm^3 occurred. This transverse energy increase may be due to turbulent heating of the plasma in the resonant layer. (auth)

31035 STIMULATED SCATTERING EFFECTS ON INCIDENCE OF AN ELECTROMAGNETIC PULSE ON A PLASMA LAYER. Al'ber, Ya. I.; Krotova, Z. N.; Mityakov, N. A.; Rapoport, V. O.; Trakhtengerts, V. Yu. (Scientific-Research Radiophysics Inst., Gorky, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 2, 574-578(Feb 1974). (In Russian).

Self-action of an electromagnetic pulse in a finite thickness plasma layer related to stimulated scattering (parametric instability) is considered. The self-action is manifest in amplitude modulation effects and anomalous absorption of the initial signal. Results are presented of a numerical calculation and also of analytical estimates of the formation of plasma turbulence spectra on development of parametric instability and of effects of self-action of the exciting wave. (auth)

31036 SLOW-WAVE COUPLING TO THE LOWER-HYBRID RESONANCE. Puri, S.; Tutter, M. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 14: No. 1, 93-101 (Jan 1974).

Previously, it has been shown that in a cold, inhomogeneous, magnetized plasma half-space the lower-hybrid resonance is accessible to the transverse-magnetic (TM) plane waves incident on the vacuum–plasma interface at an approximately grazing incidence, provided that at the hybrid layer $\omega_{pe}/\omega_{ce} \lesssim 0.4$. These results are extended to the slow-wave case when n_z, the refractive index in the static magnetic field direction, exceeds unity. It is found that the plasma is indeed accessible to the slow waves if Golant's accessibility criterion $n_z > 1 + (\omega_{pe}/\omega_{ce})^2$ is satisfied. The following recommendations can be made for coupling rf energy to the lower-hybrid resonance: (i) if $\omega_{pe}/\omega_{ce} \lesssim 0.4$, efficient coupling is possible by launching TEM-like waves on the plasma column, (ii) if $\omega_{pe}/\omega_{ce} \gtrsim 0.4$ and if the transverse machine dimensions exceed the rf vacuum wavelength, it is possible to couple TM waves using passive slow-wave structures inside the machine walls, (iii) if $\omega_{pe}/\omega_{ce} \gtrsim 0.4$, but for smaller machine dimensions, recourse must be taken to transverse-electric slow-wave coupling with current-carrying coils of appropriate periodicity. If, as was pointed out by Glagolev, propagation from the plasma edge to the hybrid layer is not materially affected by the inclusion of finite-temperature effects, by far the most elegant solution (with potential application to thermonuclear plasmas) for coupling rf energy from the second to the twentieth ion-cyclotron harmonic waves is by launching TEM-like waves in the coaxial waveguide formed by the plasma column and the containing walls. (auth)

31037 PARAMETRIC EXCITATION OF ELECTRON CYCLOTRON OSCILLATIONS OF A PLASMA IN AN ALTERNATING ELECTRIC FIELD. Kitsenko, A. B.; Lominadze, D. G.; Stepanov, K. N. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 66: No. 2, 611-621(Feb 1974). (In Russian).

Parametric excitation of electron cyclotron oscillations in a plasma is studied in a broad range of pumping field strength when the growth rate considerably exceeds the ion cyclotron frequency. The dependence of the maximal growth rate on the pumping field amplitude is determined. The effective collision frequency for which saturation of parametric instability occurs is found. (auth)

31038 EXPERIMENTAL STUDY OF THE ABSORPTION OF AN RF FIELD BY THE POSITIVE-COLUMN PLASMA. Kuzovnikov, A. A.; Khadir, M. A. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 18: No. 4, 639-641(Apr 1973).

Translated from Radiotekh. Elektron.; 18: No. 4, 875-877(Apr 1973).

The rf power absorbed in the plasma boundary layer was studied. The absorbed power was estimated from the change in the longitudinal electric field. The power balance equations for the positive column were analyzed. (MOW)

31039 NONLINEAR EXCITATION OF ION-ACOUSTIC WAVES IN A CONFINED PLASMA. Kuzovnikov, A. A.; Sviridkina, V. S.; Tarasova, V. V. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 18: No. 4, 637-638(Apr 1973).

Translated from Radiotekh. Elektron.; 18: No. 4, 873-874(Apr 1973).

The nonlinear effects occurring with the resonance excitation of standing ion-acoustic waves by an external rf field in a nonisothermal confined plasma were investigated. The ion-acoustic waves were excited in the direction perpendicular to the longitudinal axis of a dc discharge, burning in a glass discharge tube in helium. (MOW)

31040 DIFFRACTION OF FAST MAGNETO-ACOUSTIC WAVES ON A LAYER OF PLASMA PERTURBED BY A WAVE PASSING THROUGH. Tsoler, D. L.; Burduzhan, I. Magn. Gidrodin.; No. 3, 47-52(1973). (In Russian).

A transparent optical medium through which a supersonic wave passes is considered. Passage of the wave causes periodic changes in density such that the distance between maxima are equal to the length of the perturbing wave, and the perturbed layer is a diffraction lattice for the light wave falling on it. In order to obtain the diffraction picture the propagation velocity and the frequency of the diffracted wave should substantially exceed the velocity and frequency of the perturbing wave. The length of the diffracted wave should still not be much less than the length of the perturbing wave. The plasma density depends on the time and one of the coordinates. An expression is obtained for small perturbations of the magnetic field, and for the velocity and density of a plasma according to the characteristics of the diffracted wave. These diffraction phenomena may be found in discharge tubes in which periodic changes in density can occur. Thus, at various points of the plasma there may appear zones in which the magnetic field, the density or electric field exceed the values in surrounding zones. Similar phenomena can also be found in plasma traps. (SJR)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 29789, 29806, and 30147.

31041 (AD-766140-8) VALIDITY OF SCALE-MODELING FOR GAMMA-RAY ATTENUATION. Final Report. Verser, F. A.; Donnert, H. J. (Kansas Engineering Experiment Station, Manhattan (USA)). 1 Sep 1973. Contract DAHC20-71-C-0305. 179p. (KEES-SR-113). NTIS $5.25.

An adjoint Monte Carlo code (GADJET) was used to calculate the exposure rate in full-scale and model structures located in the center of plane fallout fields (1 Ci/square ft of cobalt-60). Problems were run for a standard detector, an open basement, a basement with two thicknesses of covers, and a blockhouse with two thicknesses of walls. For all configurations investigated, the effects of nonscaling of the ground does not cause any problem and a procedure was developed to minimize the error introduced by non-scaling of the air. If the solid angle subtended by the roof remains unchanged, scaling of roof contamination offers no problems. The lip effect can be significant in structures with the detector below grade. (GRA)

31042 (AD-768414-5-GA) USER'S GUIDE TO VERSION 2 OF ATR (AIR TRANSPORT OF RADIATION). Huszar, L.; Nesseler, L. J.; Woolson, W. A. (Science Applications, Inc., La Jolla, Calif. (USA)). Apr 1973. 92p. (SAI-73-534-LJ; DNA-3144-Z). NTIS $3.75.

The document is intended to serve as a user's manual for Version 2 of the ATR computer program. ATR (derived from Air Transport of Radiation) provides accurate, inexpensive and easily understood solutions to radiation environment problems at all altitudes in the atmosphere with a simple set of input commands. ATR contains parametric models of a comprehensive data base of air transport results generated by discrete ordinates techniques. The data base was generated for neutrons, secondary gamma rays, prompt gamma rays, and x-rays as a function of source energy, range, detector energy, and angle to a distance of 550 g/square cm of infinite, homogeneous air. Results at all combinations of distance and density are obtained by integral mass scaling upon infinite, homogeneous air results. Effects of the interface between air and ground and of nonuniform air density are treated as perturbation corrections. ATR resides in less than 54 k of core on the Univac 1108, uses no peripheral storage, functions effectively in a time-sharing environment, and typically uses less than a single computational second per problem. (auth) (GRA)

31043 (HEDL-TME-73-59) DISPLACEMENT CROSS SECTIONS FOR Fe, Cr, Ni, 18/10 SS, Mo, V, Nb, AND Ta. Doran, D. G.; Graves, N. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1973. Contract AT(45-1)-2170. 34p. Dep. NTIS $4.00.

This report is a compendium of displacement cross section data for Fe, Cr, Ni, 18/10 SS, Ta, Nb, Mo, and V. The calculations, described elsewhere, are based largely on the ENDF/B III cross sections and employ the energy partition theory of Lindhard and co-workers. The contributions from (n,n), (n,n'), and (n,2n) processes are given graphically. The totals are given in tabular form in both a fine group structure (45 equal lethargy intervals per decade below 1 MeV, 0.1 MeV intervals above 1 MeV) and in a one-quarter lethargy group structure. The estimated contributions from (n,γ) recoils are also given in the latter form. For Fe, displacement cross sections and primary cross sections are given for primary thresholds of 40 eV, 3 keV, and 10 keV. Finally, the iron data are averaged over several fast reactor spectra and a fission spectrum. (8 figures, 6 tables) (auth)

31044 (LA-5137) COUPLED NEUTRON-GAMMA MULTIGROUP-MULTITABLE CROSS SECTIONS FOR 29 MATERIALS PERTINENT TO NUCLEAR WEAPONS EFFECT CALCULATIONS GENERATED BY LASL/TD DIVISION. Sandmeier, H. A.; Hansen, G. E.; Seamon, R. E.;,Hirons, T. J.; Marshall, A. H. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 150p. Dep. NTIS $7.60.

This report lists 42-group, coupled, neutron-gamma cross sections for H, D, T, ^{3}He, ^{4}He, ^{6}Li, ^{7}Li, Be, ^{10}B, ^{11}B, C, N, O, Na, Mg, Al, Si, Cl, A, K, Ca, Fe, Cu, W, Pb, ^{235}U, ^{238}U, ^{239}Pu, and ^{240}Pu. Most of these materials are used in nuclear-weapons-effects calculations, where the elements for air, ground, and sea water are needed. Further, lists are given of cross sections for materials used in nuclear weapons vulnerability calculations, such as the elements of high explosives as well as materials that will undergo fusion and fission. Most of the common reactor materials are also listed. The 42 coupled neutron-gamma groups are split into 30 neutron groups (17 MeV through 1.39×10^{-4} eV) and 12 gamma groups (10 MeV through 0.01 MeV). Data sources and averaging schemes used for the development of these multigroup parameters are given. (119 tables) (auth)

31045 (SLA-73-1026) TIGER: A ONE-DIMENSIONAL, MULTILAYER ELECTRON/PHOTON MONTE CARLO TRANSPORT CODE. Halbleib, J. A. Sr.; Vandevender, W. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 27p. Dep. NTIS $4.50.

TIGER provides experimenters and theorists with a method for the routine solution of coupled electron/photon transport in multilayer geometries. Emphasis is placed upon operational simplicity without sacrificing the rigor of the model. TIGER combines condensed-history electron Monte Carlo with conventional single-scattering photon Monte Carlo in order to describe the transport of all generations of particles from several MeV down to 1.0 and 10.0 keV for electrons and photons, respectively. The model is more accurate at the higher energies, with a less rigorous description of the particle cascade at energies where the shell structure of the transport media becomes important. Flexibility of construction permits the user to tailor the model to specific applications and to extend the capabilities of the model to more sophisticated applications through relatively simple update procedures. (auth)

31046 CALCULATION OF THE ELECTRON BREMSSTRAHLUNG IN NaI, CsI, Si, AND Ge. Grosswendt, B. (Physikalisch-Technische Bundesanstalt, Brunswick). Nucl. Instrum. Methods; 116: No. 1, 97-104(1974). (In German).

Following the method of Zerby and Moran, the bremsstrahlung spectra, the total number of emitted bremsstrahlung photons, and the bremsstrahlung yield resulting from electrons slowing down in NaI, CsI, Si and Ge were calculated. Contrary to the earlier calculations the Sternheimer density-effect corrections, the energy loss by bremsstrahlung, and some corrections of the bremsstrahlung cross-section expressions of the Bethe-Heitler theory were taken into account. The comparison with the earlier calculations neglecting these corrections shows some discrepancies, which underline the necessity of using all corrections available. (auth)

31047 THEORY OF GENERALIZED DIFFUSION EQUATIONS. Tobol'tsev, A. M. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 597-602(1973). (In Russian).

Generalized diffusion equations whose examination was advised in the book by A. A. Vlasov were obtained. The character of the equations obtained during continuous change of the parameters of the corresponding schemes was examined. (tr-auth)

31048 CALCULATION OF THE HPRR NEUTRON SPECTRUM FOR SIMULATED NUCLEAR ACCIDENT CONDITIONS. Poston, J. W.; Knight, J. R.; Whitesides, G. E. (Oak Ridge National Lab., TN). Health Phys.; 26: No. 3, 217-221(Mar 1974).

Since 1964, the Health Physics Research Reactor (HPRR) at the Oak Ridge National Laboratory has been used to simulate nuclear excursions to allow intercomparisons of accident dosimetry systems. Generally, activation foils or threshold-activation foils are used to measure the neutron fluence. Usually, data from these detectors are used to provide the neutron dose and the general shape of the neutron energy spectrum. However, some participants have used an iterative technique to calculate a spectral distribution to fit the experimental results. A calculational study was begun to provide the HPRR neutron spectrum for three typical accident exposure conditions. Results of these calculations are compared with spectra derived from the use of several dosimeters under actual exposure conditions at the HPRR. Also included in the results of the calculation were neutron dose distributions as a function of distance from the reactor. These results are compared with the results of measurements performed during the Intercomparison Study of 1971. (auth)

31049 APPLICATION OF HIGH ENERGY CHARGED PARTICLES TO MEDICINE. Gol'din, L. L.; Dzhelepov, V. P.; Lomanov, M. F.; Savchenko, O. V.; Khoroshkov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Usp. Fiz. Nauk; 110: No. 1, 77-99(May 1973). (In Russian).

The biological effectiveness and the methods and techniques of irradiation with heavy charged particles are examined. The advantages which can be obtained by use of heavy charged particles in radiation therapy and radioneurosurgery are discussed. The characteristics of the dose distribution and the biological effects of different radiations are considered. An evaluation is made of the future of heavy charged particles in medicine. A review is

presented on the world data on present uses of heavy charged particles. (tr-auth)

31050 NEUTRON DOSE DISTRIBUTION IN TISSUE-EQUIVALENT PHANTOMS. Obaturov, G. M. (Physical Energy Inst., Obninsk, USSR); Shalin, V. A.; Keirim-Markus, I. B.; Kochetkov, O. A. pp 141-176 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

Published data on the distribution of absorbed neutron doses and neutron spectra in tissue-equivalent phantoms are reviewed. There is a more detailed discussion of data, obtained by the authors and others, on the distribution of tissue doses in a tissue-equivalent, infinite, elliptical cylinder simulating a human torso for different neutron energies and angles of incidence, and on neutron spectra in a tissue-equivalent slab 30 cm thick. In conclusion, the authors make suggestions regarding further research in this branch of dosimetry. (59 references) (auth)

31051 STANDARDIZING THE FLUENCE-TO-DOSE-EQUIVALENT CONVERSION FACTORS FOR WHOLE-BODY NEUTRON EXPOSURES. Stevenson, G. R. (CERN, Geneva); Hoefert, M.; Neufeld, J.; Rindi, A.; Routti, J. T.; Pretre, S. pp 177-191 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The present recommendations given for converting fluence to dose-equivalent are shown to be over-conservative in the sense that they do not always meet requirements of additivity and cumulativity. Considerations are given for a proposal that the evaluation of radiation risk should be based on the surface dose-equivalent. Different geometries of irradiation are considered and fluence-to-dose-equivalent conversion factors are recommended. (auth)

31052 EXPERIMENTAL DETERMINATION OF DOSE-EQUIVALENT AND QUALITY FACTOR IN A CYLINDRICAL PHANTOM IRRADIATED WITH REACTOR NEUTRONS. Pszona, S. (Inst. of Nuclear Research, Swierk, Poland). pp 193-199 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The results of determinations of dose-equivalent (DE) and quality factor (QF) depth distribution in a cylindrical phantom irradiated in a spectrum of reactor neutrons are presented. The detectors used in the experiment consisted of a conjugate set of a TE ionization chamber and an organic scintillator NE 102A with an EMI 9524S photomultiplier. As a detector insensitive to neutrons, an NE 226 hydrogen-free scintillator was used. The phantom was cylindrical, 30 cm in diam. × 60 cm long, and filled with TE liquid. The measurements were carried out in the radiation fields of a light-water swimming-pool research reactor and of the pulsed reactor IBR-30. The quality factor values at the surface of the phantom were: (1) in mixed radiation of the swimming pool reactor at 2.5 cm distance from the reactor core, 4.2 ± 0.1; (2) in mixed radiation of the pulsed reactor IBR-30 at 84 m distance from the reactor core, 7.2 ± 0.3; and (3) in the neutron spectrum of the pulsed reactor IBR-30 at 84 m distance from the reactor core, 8.0 ± 0.3. (auth)

31053 DEPTH-DOSE MEASUREMENTS OF D-T NEUTRONS IN TISSUE-EQUIVALENT PHANTOMS. Broers-Challiss, J. E.; Engels, A. C.; Bouts, C. J.; Broerse, J. J. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 201-210 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

Measurements of the radiation field in a phantom, with regard to the neutron components and the contaminating gamma-radiation, are essential for purposes of radiation protection and radiotherapy. In connection with clinical applications of 15-MeV neutron beams, depth-dose measurements were carried out with different tissue-equivalent phantoms for total-body exposures and collimated neutron beams of various field sizes. The distribution of neutron and gamma doses over the phantoms was determined by means of a number of devices, e.g., ionization chambers, Geiger-Müller counters and thermoluminescent dosimeters. The dosimetry results obtained from the phantom measurements are discussed in relation to the theoretical and experimental data obtained for conditions of similar geometry. (auth)

31054 CONDITIONS OF IRRADIATION OF BIOLOGICAL MATERIAL IN NUCLEAR REACTORS. Kirichinskii, B. R.; Chebotarev, E. E. pp 3-8 of Biofizika i Radiobiologiya, Vypusk 3. Chebotarev, E. E. (ed.). Kiev; Naukova Dumka (1972). (In Russian).

The need for unifying conditions for organizing and carrying out experiments to compare results of radiobiological studies in nuclear reactors was studied. Unification should, first, consider the physical conditions of irradiation and the technology of making dosimetric measurements. Recommendations are made on the unification of such irradiation conditions as the type (acute, chronic, local), dose, composition of the beam and its homogeneity, and unification of the irradiation and dosimetry methods. Problems related to the amount of information needed on improving conditions for carrying out experiments on comparative radiation effects of different types of radiation are discussed. (tr-auth)

31055 SIMPLE COMPUTER PROGRAM TO CALCULATE THE RADIATION FIELD IN THE PRESENCE OF A RIGHT CYLINDRICAL SOURCE. German, U.; Liran, J. (Israel Atomic Energy Commission, Beersheba). Atomkernenergie; 22: No. 4, 285-289(1974).

A simple computer program was developed to calculate the radiation field near a cylindrical, arbitrarily distributed source. The point kernel method is used and the source can be surrounded by cylindrical and planar shields. Reasonable computing times are needed for good accuracy. The results are consistent with experimental values and results obtained by others. (GF)

31056 FORWARD AND BACKWARD PHOTOEMISSION YIELDS FROM METALS AT VARIOUS X-RAY ANGLES OF INCIDENCE. Bernstein, M. J.; Paschen, K. W. (Aerospace Corp., El Segundo, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 111-116(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

X-ray generated photoemission from thin metal foils backed by graphite was measured with radiation incident from the front and back sides at several angles. Irradiation was provided by a 100-kV x-ray tube with three different filters to harden the spectrum. The 2π photoelectron emission current from a surface was measured; a biased grid retarded the low-energy secondary electrons, which added only 10-30% to the current at zero grid bias. Investigated metals were: Mg, Al, Ti, Fe, Cu, Ag, Ta, Au, and Pb; also the total emission from just the graphite support was measured. The front-to-back ratio of emission currents at normal incidence ranged from about 1.9 for Al and Mg down to about 1.1 for Ta. The photoelectron yield was found to be $G_e \mu_e S_e$ electrons/photon, where μ_e and S_e are the energy-dependent photon absorption cross section and computed electron mean path length in the emitter, and G_e is a constant assumed independent of photon energy in the range studied (but does depend on radiation angle of incidence). For the photon energy range of 20-70 keV, the measured emission current densities corresponded to the following average values for G_e: 0.37 ± 0.06 for C, 0.30 ± 0.03 for Al, 0.21 ± 0.02 for Cu and Ag, and 0.18 ± 0.02 for Ta. (auth)

31057 X-RAY INDUCED ELECTRON EMISSION. II. Bradford, J. N. (Air Force Cambridge Research Labs., Bedford, MA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 105-110(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

The x-ray induced photoemission measurements made at AFCRL have been used as a basis for comparison to the computed results of the POEM Monte Carlo electron transport code. The results show spectral shapes which closely resemble the experimental data and absolute yield values which agree within 15-27%. The measurements have been continued and the angular distributions from irradiated Al and Ta plates have been determined. The Ta distribution function for electron emission changes from cos θ about the surface normal for normally incident x-rays to isotropic for large angles of incidence. The Al in contrast changes from cos θ for normal incidence to a forward lobed shape for large angles of incidence. Both target materials show substantial yield increases at increasing angles of incidence. (auth)

31058 X-RAY PRODUCED CHARGE DISTRIBUTIONS AT INTERFACES BETWEEN MATERIALS OF DIFFERENT ATOMIC NUMBER. Kooi, C. F.; Kusnezov, N. (Lockheed Palo Alto Research Lab., Palo Alto, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 6, 97-104(Dec 1973).

From annual conference on nuclear and space radiation effects; Logan, UT (23 Jul 1973).

X-rays traversing a material deposit charge near an interface between two different materials. Results of measurement and calculation of these charge distributions are presented. The measurements were made using a planar dielectric-filled Faraday

cup. The charge was calculated using primarily the Compton and photoelectric effects, experimental electron ranges, and experimental electron reflection coefficients. The charge distributions near the interface were determined for the Compton, photoelectric, and mixed Compton-photoelectric regimes: for each of these, the x-ray direction was from low to high atomic number and also in the opposite direction. (auth)

31059 GAMMA AND NEUTRON SURFACE DOSE RATE MEASUREMENTS: THEORETICAL AND PRACTICAL. Helgeson, G. L. (Helgeson Nuclear Services, Inc., Pleasanton, CA). pp 651-675 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Direct measurement of gamma or neutron surface dose rates is generally impossible. The mathematical approach to surface dose rate measurements from sources of differing geometries, such as cylindrical bottles of reactor coolant or radiochemicals, flux wires, fuel rods, pipes, plates and discs is discussed. Typical examples are given. Since the radiation monitoring technician usually doesn't have the time to make detailed calculations under field conditions, rules of thumb are given which give surprisingly good agreement with theoretical calculations. (auth)

Radiation Protection Standards

Refer also to abstracts 29650 and 29783.

31060 (FDA-73-8029, pp 545-550) PROBLEMS RELATED TO DOSE REDUCTION IN THE HEALING ARTS: AEC REGULATORY OVERVIEW. Grove, G. R.; Dragonette, K. S. (AEC, Washington, DC). Mar 1973.

In health physics in the healing arts.

The AEC's authority to regulate atomic energy materials used in medicine is derived from the Atomic Energy Act of 1954, as amended. The atomic energy materials which the AEC is authorized to regulate under the Act are source material (natural uranium and thorium), special nuclear material (plutonium, uranium-233, or uranium enriched in the isotope 235), and byproduct material (for example, radioisotopes produced in a reactor). With the exception of prosthetic devices such as nuclear powered cardiac pacemakers which use the special nuclear material Pu-238 as fuel, practically all radioisotopes used in nuclear medicine which are subject to AEC regulatory control are byproduct materials. The AEC does not regulate radium, accelerator produced radioisotopes, or radiation-producing machines, such as x-ray machines or linear accelerators. Current problems related to dose reduction are reviewed with specific considerations of the use of radiopharmaceuticals, pacemakers, and teletherapy units. With respect to radiopharmaceuticals, it is evident that continued efforts to improve handling procedures and to encourage the use of appropriate equipment and shielding are necessary to reduce extremity and whole-body exposure to medical personnel as the quantity and complexity of use continues to grow. Each individual user must cooperate to achieve as low as practicable personnel exposures. With respect to nuclear powered pacemakers, it appears that the current investigational use of devices will eventually lead to the establishment of standards for the manufacture and wide-scale use of these devices with minimum controls. With respect to teletherapy units, the importance of attention to mechanical devices which are essential for safety and dose reduction are emphasized. The AEC will continue to maintain cognizance over the use of atomic energy materials in the healing arts and of concomitant health physics problems and strive to provide an adequate framework for the protection of the public health and safety with the full recognition of the accrued benefits to patients. (auth)

31061 (FDA-73-8029, pp 552-557) NUCLEAR INDUSTRY STANDARDS: ROLE OF ANSI--NTAB IN PREPARATION AND APPROVAL. Savolainen, A. W. (American National Standards Inst., New York, NY). Mar 1973.

In health physics in the healing arts.

The Nuclear Technical Advisory Board (NTAB) of the American National Standards Institute (ANSI), one of 20 such Boards, has responsibility for fostering, maintaining, and coordinating nuclear standards. The current NTAB program is placing increased emphasis on the development of standards for radiation protection instrumentation and methods of application; techniques for bioassay; facilities and methods for production of radiopharmaceuticals; facilities, methods, and equipment for use of radioactive sources; methods and equipment for use of accelerators in medical therapy; facilities for radiation therapy and diagnostic radiology; and design criteria for hospital nuclear medicine laboratories. Development of the standards of specific interest in the healing arts is the responsibility of two ANSI Standards Committees: N13, Radiation Protection, and N44, Equipment and Materials for Medical Radiation Applications. Both these committees look to the Health Physics Society for major input in all aspects of radiation protection of personnel. (auth)

31062 (FDA-73-8029, pp 564-566) FEDERAL PERFORMANCE STANDARD FOR DIAGNOSTIC X-RAY EQUIPMENT. Elder, R. L.; Britain, R. G.; Barone, G. J. (Food and Drug Administration, Rockville, MD). Mar 1973.

In health physics in the healing arts.

31063 (FDA-73-8029, pp 568-571) FDA RADIOACTIVE MEDICAL DEVICE PROGRAM. Schmidt, G. D.; Link, D. M. (Food and Drug Administration, Rockville, MD). Mar 1973.

In health physics in the healing arts.

31064 (FDA-73-8029, pp 572-575) EQUIPMENT AND MATERIALS FOR MEDICAL RADIATION APPLICATIONS: ANSI STANDARD COMMITTEE N44. Dahl, A. H.; Hickey, J. L. S.; McDowell, R. B.; Schmidt, G. D.; Cooper, J. F. (Food and Drug Administration, Rockville, MD). Mar 1973.

In health physics in the healing arts.

The ANSI Standards Committee N44 is the national focal point for promoting and developing voluntary consensus standards pertaining to equipment and materials for medical radiation applications. The committee's areas of concern include radioactive materials, accelerators, and x-ray equipment. The scope of the Nuclear Technical Advisory Board excludes the judgmental factors related to application of radiation to humans for medical purposes; that is, matters related to decisions to use radiation, to interpretation, and to diagnosis. Standards, therefore, concentrate on safe, efficient, and effective use of radiation, including radiation sources, equipment, facilities, protocols, and conditions of use. (auth)

31065 (FDA-73-8029, pp 624) ROLE OF REVIEW OF MANUFACTURER REPORTS AND QUALITY CONTROL PROGRAMS IN ENFORCEMENT OF THE FEDERAL DIAGNOSTIC X-RAY PERFORMANCE STANDARD. Robinson, E. W.; Lieberman, S. H. (Food and Drug Administration, Rockville, MD). Mar 1973.

In health physics in the healing arts.

31066 IMPLEMENTATION OF PERSONNEL SAFETY FEATURE STANDARDS ON RADIATION FACILITIES IN AN INDUSTRIAL PLANT. West, C. M.; Roberts, E.; Jones, D. A. (Union Carbide Nuclear Corp., Oak Ridge, TN). Amer. Ind. Hyg. Ass. J.; 34: No. 12, 547-553(Dec 1973).

The Oak Ridge Y-12 Plant is a nuclear weapon component production and development complex operated by Union Carbide Corporation for the United States Atomic Energy Commission. More than 100 x-ray or γ radiographic source units required to carry out the plant's mission are in the process of being upgraded to meet the Personnel Safety Feature Standards developed by representatives of the plant's maintenance, engineering, operations, and radiation safety groups. The development and general implementation of the standards are outlined. Examples, selected to illustrate how specific standards have been implemented and how this implementation has improved radiation safety, are presented in detail. (auth)

31067 EXECUTION OF THE NEW X-RAY ORDINANCE BY THE AUTHORITIES OF THE LAENDER. Rosenbaum, O. (Landes Nordrhein-Westfalen, Duesseldorf). Arbeitsschutz (Colohne); No. 4, 158-160(1973). (In German).

The individual Laender Governments will have to determine the civil authorities that shall be competent to supervise the execution of the provisions of the X-ray Ordinance. The decisions taken by the Land Northrhine-Westphalia are given as an example illustrating the functions of these administrative authorities with respect to the new X-ray Ordinance. (GE)

31068 PROGRESS ON SURFACE CONTAMINATION STANDARDS. Gallagher, F. E. (California Inst. of Tech., Pasadena); Tschaeche, A. N.; Willis, C. A.; Evraets, J. C.; Rogers, J. C. pp 1767-1781 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

A surface contamination standard is being developed, based on the following principles: Non-zero permissible surface contamination limits should be based on health and safety criteria. The standard must include limits for controlled and uncontrolled areas. These are not necessarily proportional to each other.

The standard must be constructed around the consideration that the limits chosen for uncontrolled areas may become a universal level of contamination. Fallout, the major source of data for environmental contamination, indicates that the principle path to man is foodstuff contamination. Uncontrolled area limits should, therefore, be based upon data obtained from studies of radioactive fallout from weapons testing. The limits should be selected so that surface contamination produces only a fraction (perhaps 10%) of the permissible dose. Special cases, such as a plutonium dispersal following a weapons accident may require a different set of limits than those derived from fallout levels in uncontrolled areas. Administrative controls need not be based on hazard, but may take into consideration such requirements as clean low level counting rooms, etc. (auth)

31069 INTERNAL DOSIMETRY PROBLEMS, DEFINITIONS, AND STANDARDS. Tschaeche, A. N. (General Electric Co., San Jose, CA). pp 1783-1816 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

The current ICRP Recommendations, and Atomic Energy Commission, and agreement, State Regulations on exposure to internal radiation are presented and compared. Some problems of applying these recommendations and regulations in a practical operations situation are described. A set of definitions of terms used in reference to internal dosimetry is presented as a step towards solution of these problems. Problems of analysis for bioassay samples are described. The plight of those who must use commercial vendors for analysis of bioassay specimens is discussed. The problem of accuracy in internal dosimetry is discussed with specific reference to operational situations and the actions of managers in these situations. Much experience is available on which to base operational internal dosimetry programs. However, some consistency must be obtained between programs. Standards are a way of obtaining this consistency. Examples of the kinds of standards needed are given and methods by which these standards may be obtained are discussed. (auth)

Radiation Source Calibration and Standardization

Refer also to abstracts 29713 and 29720.

31070 (AD-763333) DATA PROCESSING SYSTEM FOR STANDARDIZATION OF GAMMA AND NEUTRON CALIBRATORS. Summerer, R.; Brown, B. (Naval Ordnance Lab., White Oak, Md. (USA)). 10 Apr 1973. 71p. (NOLTR-73-58). NTIS $3.00.

A data processing system was developed to process and analyze data taken in the field standardization of shore-based gamma and neutron calibrators. The gamma calibrator, the AN/UDM-1A, is used to calibrate several types of gamma radiation detection instruments (radiacs). The neutron calibrator, the MX-9335 (XWO-1)/UDM, is used to calibrate a neutron detecting radiac set, the AN/PDR-70. Two computer programs process data taken from sets of transfer standard instruments which are used to measure dose rate as a function of distance. One program is used to analyze the data, compute a linear regression line, and calculate several statistical parameters. In a second program, a series of tables are printed which list the distances at which specified dose rates are generated by the calibrator. The tables are dated and corrected for activity changes in the calibration sources. (auth)

31071 (FDA-73-8029, pp 149-155) CALIBRATION OF MEDICAL DIAGNOSTIC X-RAY EQUIPMENT. Rothenberg, L. N. (Memorial Hospital for Cancer and Allied Diseases, New York, NY). Mar 1973.

In health physics in the healing arts.

31072 (FDA-73-8029, pp 163-173) ROUTINE EVALUATION OF THE DIAGNOSTIC X-RAY EQUIPMENT IN A LARGE HOSPITAL. Collier, W. C. (Univ. of Southern California Medical Center, Los Angeles). Mar 1973.

In health physics in the healing arts.

31073 (FDA-73-8029, pp 179-183) IMPROVED METHOD FOR QUALITY CONTROL IN DIAGNOSTIC RADIOLOGY. Cameron, J. R.; Bassano, D. A.; Bank, M. I. (Univ. of Wisconsin, Madison). Mar 1973.

In health physics in the healing arts.

31074 (FDA-73-8029, pp 203-206) RELIABILITY OF COBALT-60 TELETHERAPY UNITS. Doppke, K. P.; Lane, R. G.; Tulbert, D. D. (Univ. of Wisconsin Hospitals, Madison). Mar 1973.

In health physics in the healing arts.

31075 (INIS-mf-834) CALIBRATED ACTINIDE NUCLIDE SOURCES. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). 1973. 3p. INIS.

An account is given of the preparation and calibration of alpha active sources in the range 0.001 μCi to 100 mCi and of californium 252 spontaneous fission sources. The individual nuclides that can be selected are listed for (a) high resolution and standard alpha sources, (b) alpha energy calibration sources containing a mixture of four or five long-lived nuclides, and (c) targets for the measurement of nuclear constants. Alpha radiation sources using curium 242 are described under (a) air ionizing electrodes and (b) disc sources. Californium 252 sources for fission fragment energy calibration are described. An alpha spectrometry service is available for the analysis of mixtures of alpha emitting nuclides. (UK)

31076 CALIBRATION OF AN Am–Be NEUTRON SOURCE BY THE MANGANESE SULFATE BATH METHOD. Rotondi, E. (CNEN, Rome). Energ. Nucl. (Milan); 21: No. 1, 50-52 (Jan 1974).

The absolute calibration of an Am–Be neutron source, carried out at the Casaccia Nuclear Studies Centre of CNEN, to make available a national fast neutron source standard is described in detail. The calibration was performed by the manganese sulphate bath method. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 29747, 30236, 30238, and 31230.

31077 (FDA-73-8029, pp 267) PLATE GLASS SHIELDING IN ROENTGENOLOGICAL INSTALLATIONS. Vacirco, S. J.; Thompson, D. L.; Becker, J. (State Univ. of New York, Brooklyn). Mar 1973.

In health physics in the healing arts.

31078 CALCULATION AND COMPARISON OF LEAKAGE NEUTRON SPECTRA. Makra, S.; Palfalvi, J.; Zarand, P. (Central Research Inst. for Physics, Budapest). pp 47-57 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The spectra of monoenergetic, fission and reactor source neutrons that had passed through shields were calculated and compared with literature data. The following shield compositions were considered: water, polythene, concrete, aluminium, beryllium and iron. The thickness of the shields ranged from 5 cm up to 190 cm. Different spectra were unified by a computer code; 48-group flux, kerma and dose-equivalent spectra were determined. The authors compare their own calculations with literature data, and make recommendations for the use of the spectra for dosimeter evaluation. (auth)

31079 ESTIMATING THE CONTRIBUTION OF NEUTRONS SCATTERED INSIDE BUILDINGS TO TOTAL RADIATION DOSES. Savinskii, A. K.; Filyushkin, I. V. (Inst. of Biophysics, Ministry of Public Health, Moscow). pp 211-222 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

A straightforward method for estimating the contribution of scattered neutrons to total flux or radiation dose is described. The method is based on results obtained by measuring the fluxes and spectra of neutrons emitted by a Pu–Be source and scattered in rooms of different sizes and on published albedo data for neutrons of different energies scattered by concrete. Simple expressions are obtained which relate different characteristics of the scattered neutron field (flux, kerma, etc.) to the source output and the room dimensions. The proposed method can be used with any neutron sources in rectangular rooms with concrete floors, walls and ceilings provided that the length of the room is not more than three times the width. The neutron source can have any spectral composition. (auth)

PHYSICS (THEORETICAL)

31080 USE OF THE DENSITY MATRIX METHOD TO DESCRIBE THE POLARIZED MOESSBAUER TRANSITIONS IN MIXED HYPERFINE INTERACTIONS. Barb, D.; Tarina, D. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 10, 1209-1218(1973).

A relation between the two-dimensional complex vector parametrization and the photon polarization density matrix was used to describe the changes of the polarization state of the Mössbauer radiation in the presence of mixed hyperfine interactions. (auth)

General

Refer also to abstracts 31272 and 31666.

31081 (CONF-710124-) PROCEEDINGS OF THE CONFERENCE ON CLIFFORD ALGEBRA, ITS GENERALIZATION AND APPLICATIONS, [COTACAMUND, INDIA], 30th JANUARY–1st FEBRUARY 1971. Ramakrishnan, A. (Ed.). (Institute of Mathematical Sciences, Madras (India)). [nd]. 116p.

The conference covers generalized Clifford algebra and linearizations of partial differential equations, structure of algebra extension of finite Abelian group, projective representations of finite groups, generalized Clifford algebra and its applications or a new approach to internal quantum numbers, and generalized spinor structure. (JFP)

31082 (INP-855) MULTIPLICATION LAW IN QUANTUM PHYSICS. Part I. The Non-Relativistic Quantum Mechanics. Kapuscik, E. (Institute of Nuclear Physics, Krakow (Poland)). Nov 1973. 24p. Dep. NTIS (U. S. Sales Only) $4.25.

A generalization of the Heisenberg quantum theoretical multiplication law is proposed. What kind of modification this introduces to the usual results of quantum mechanics is shown. The large domain of applicability of the generalized product is indicated. (auth)

31083 (ITF-73-155-P) CLEBSCH–GORDAN COEFFICIENTS FOR THE DIRECT PRODUCT $[m_n] \times [1]$ OF THE GROUP SO(n) REPRESENTATIONS. Gavrilik, A. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 33p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.75.

For the case of the direct product $[m_n] \otimes [1]$ of an arbitrary SO(n)-group representation and the vector one, the exact formulas for all isofactors are obtained. By means of these isofactors matrix elements of the operators $I_{n+1,i}, 1 \leq i \leq n$ of the group SO(n+1) algebra are written down. (auth)

31084 (ORO-3992-161) RIGGED HILBERT SPACE AND QUANTUM MECHANICS. Bohm, A. (Texas Univ., Austin (USA). Center for Particle Theory). 1974. Contract AT(40-1)-3992. 38p. (CPT-205). Dep. NTIS $5.00.

Quantum mechanics is developed using the example of the harmonic oscillator. (JFP)

31085 (ORO-3992-178) DETERMINATION OF THE RELATIVISTIC WAVE EQUATIONS ASSOCIATED WITH A GIVEN REPRESENTATION OF SL(2,C). Hurley, W. J.; Sudarshan, E. C. G. (Texas Univ., Austin (USA). Center for Particle Theory). 1974. Contract AT(40-1)-3992. 14p. (CPT-222). Dep. NTIS $4.00.

Straight-forward algebraic techniques are presented and used to determine the structure of all possible wave equations whose relativistic covariance is governed by two representations of SL(2,C), $S_0(\Lambda) = (1,\frac{1}{2}) \oplus (\frac{1}{2},1) \oplus (\frac{1}{2},0) \oplus (0,\frac{1}{2})$ and $S_1(\Lambda) = S_0(\Lambda) \oplus (\frac{1}{2},0) \oplus (0,\frac{1}{2})$, subject to the requirements that the equations should be parity preserving, admit an invariant Hermitian bilinear form realized by a numerical matrix, η, and that they should describe a particle with a unique mass and spin. It is shown that $S_0(\Lambda)$ leads to a unique algebraic structure, that of the Rarita-Schwinger equation; whereas $S_1(\Lambda)$ leads either to a trivial extension of the former case or to a family of equations whose matrices have a minimal algebra with degree one higher than that of the former case. One such example reproduces the equation presented by Glass. When, contrary to custom, a singular η-matrix is considered it is shown that $S_1(\Lambda)$ allows for equations whose coefficient matrices are reducible but indecomposable. These equations are completely equivalent to the Rarita-Schwinger equation in the free case but the added components may enter the dynamics in the presence of certain interactions. The present examples serve to illustrate techniques which may be applied in the study of any relativistic wave equation. (auth)

31086 NOTE ON DETERMINING RESONANCE WIDTHS IN THE PRESENCE OF GAUSSIAN ERRORS. McEwen, J. G.; Daniell, G. J. (Univ. of Southampton, Eng.). Nucl. Instrum. Methods; 116: No. 1, 169-170(1974).

This note derives a simple memorable relation which is a reliable guide in predicting or interpreting the effects of Gaussian errors on Breit–Wigner distributions. (auth)

31087 RIGOROUS UPPER AND LOWER BOUNDS ON QUANTUM MECHANICAL MATRIX ELEMENTS. Blau, R. New York; New York Univ. (1973). 64p. University Microfilms Order No. 74-1846.

Thesis (Ph. D.).

Rigorous upper and lower bounds on the diagonal and off-diagonal bound state matrix elements of a quantum mechanical operator are derived which represent a significant improvement over previous results in that they are valid for practically all Hermitian operators of interest and all first-order error terms are eliminated. These bounds do, however, contain error terms of the three-halves power of the errors of the trial functions used; they are therefore termed "quasi-stationary" bounds. In the particular but important case of the diagonal bound state matrix elements of nonnegative (nonpositive) but otherwise arbitrary Hermitian operators, true stationary lower (upper) bounds are obtained; the errors are of second order in the errors of the trial functions used. All trial functions can contain variational parameters, which may be varied to produce the best bounds. The results obtained are tested by computing upper and lower bounds on the expectation value of the electron-nucleus distance for the ground state of helium, with rather good results. As a preliminary to the quasi-stationary and stationary bounds, non-stationary, variational bound formulas, i.e., bounds containing first order error terms, are first derived. In general, the quality of such bounds will not be as good as that of the stationary or quasi-stationary bounds, but less computational effort is required to obtain them. They are therefore not entirely superceded by the stationary types. (Diss. Abstr. Int., B)

31088 COMMENT ON A RECENT PAPER OF MIGNANI AND RECAMI. Yaccarini, A. (Univ. Laval, Quebec). Lett. Nuovo Cim.; 9: No. 9, 354-356(2 Mar 1974).

It is shown that the formalism of Mignani and Racami for generalized Lorentz transformations in four dimensions, connecting subluminal frames to superluminal frames, is inadequate. It is suggested that introducing superluminal frames in M^4 cannot be achieved in a consistent way if one uses a real Minkoroski space, and that only a complex space will lead to the solution of the problem. (LBS)

31089 INTERPRETING SUPERLUMINAL LORENTZ TRANSFORMATIONS: ANSWER TO THE COMMENTS BY YACCARINI. Mignani, R.; Recami, E. (Univ., Catania, Italy). Lett. Nuovo Cim.; 9: No. 9, 357-361(2 Mar 1974).

It is argued that the criticism by Yaccarini (Lett. Nuovo Cimento 9 : 354 (1974) on extending special relativity to superluminal frames and to faster-than light objects is not well founded. Clarification is given on the interpretation of superluminal Lorentz transformations. (LBS)

31090 THERMODYNAMICS AND STATISTICAL MECHANICS. Volume I. Introductory Theory. Ruei, K. H. Particles and Fields. Taipei, Taiwan; University Press (1972). 427p. Richard Abel and Co., Inc., Portland, OR, $10.50.

The topics discussed include thermodynamic laws and fundamental theories, equilibrium systems, near equilibrium systems and irreversible processes, and statistical mechanics in the combinatorial formulation. (JFP)

31091 RANDOM PROCESSES ASSOCIATED WITH OBSERVABLE QUANTITIES IN QUANTUM MECHANICS. Claverie, P.; Diner, S. (Univ., Paris). Compt. Rend., Ser, A, B; 277: No. 20, 579-582(10 Nov 1973). (In French).

Considerations of the temporal behavior of a quantum system lead to the association of a random process with each observable for which the ergodic properties are proved. (auth)

31092 ANOMALOUS PARITY-VIOLATING BOLTZMANN DISTRIBUTION. Syros, C. (European Atomic-Energy Commission, Brussels). Lett. Nuovo Cim.; 9: No. 8, 308-310(23 Feb 1974).

An exact solution is given of the stationary Boltzmann equation for a gas confined in a space region of finite volume moving inside a constant force field. (LBS)

31093 TWISTOR QUANTIZING. The Penrose-type Quantum Theory of Particles and Geometry. Perjes, Z. (Institut du Ra-

dium, Orsay, France). Magy. Fiz. Foly.; 21: No. 5, 408-464(1973). (In Hungarian).

The program of the twistor theory is outlined, describing the problem of impulse momentum and geometry. The as yet unsolved problems of quantum theory and expected paths of new developments have been discussed at a symposium held in 1964 at Cambridge, whereby the presentation of the twistor concept by Roger Penrose made the largest impression. In that theory several, concepts, such as the point of space, are considered derived rather than elementary entities. The zero twistors, Robinson beams are described and twistor representation in spinor fields and the kinematic meaning of twistors are indicated, comparing the twistor space and the Minkowski space and mentioning the Penrose representation of zero-mass particle spaces. Sections are devoted to twistors in curved space, classical scattering processes, quantizing and interacting spaces. (Review article, 38 references) (TTT)

31094 UNITARY FOLDY-WOUTHUYSEN OPERATOR FOR ARBITRARY SPIN. Nagpal, A. K. (Univ. of Delhi); Kaushal, R. S. Lett. Nuovo Cim.; 9: No. 10, 391-394(9 Mar 1974).

It is shown that some inconsistencies arise in constructing Foldy-Wouthuysen transformation for spin >1. It is suggested that it might be due to the fact that there exists no unique mass, arbitrary-spin wave equations with subsidiary conditions for S > 1. (LBS)

31095 SOLUTIONS OF THE DIRAC EQUATION IN FINITE DE SITTER SPACE (REPRESENTATIONS OF $SO_{4,1}$). Riordan, F. (Univ. of Birmingham, Eng.). Nuovo Cim.; 20B: No. 2, 309-325(11 Apr 1974).

All the solutions of the Dirac equation in the finite space de Sitter universe are found, and it is shown that they form a basis for a representation of the group of motions for this universe, $SO_{4,1}$. The action of the generators of $SO_{4,1}$ on these solutions is explicitly given as a linear superposition of solutions. (auth)

Quantum Field Theories

Refer also to abstracts 30487, 30559, and 31131.

31096 (AD-769854) STATISTICAL MECHANICS OF ONE-DIMENSIONAL GINZBURG-LANDAU FIELDS. II. A Test of the Screening Approximation (N-1 Expansion). Ferrell, R. A.; Scalapino, D. J. (Maryland Univ., College Park (USA)). Sep 1973. Contract N00014-67-A-0239-0019. 80p. NTIS $6.00.

The classical statistical mechanics of an n-dimensional order parameter which exists in one spatial dimension are discussed. This many-body (field) problem was reduced to a quantum mechanical one-body problem which was solved numerically. It, therefore, provides a convenient testing ground for studying the convergence as well as understanding the nature of approximations used for higher spatial dimensions. It is shown how the results for finite n converge toward the n = infinity answer. In addition, the (1/n) expansion is investigated by computing the first and second order corrections to the n = infinity result. (GRA)

31097 (COO-2271-20) VACUUM STABILITY AND VACUUM EXCITATION IN A SPIN 0 FIELD THEORY. Lee, T. D.; Wick, G. C. (Columbia Univ., New York (USA)). 1974. 97p. Dep. NTIS $8.00.

The theoretical possibility that, in a limited domain in space, the expectation value, $\langle\phi(x)\rangle$, of a neutral spin-0 field may be abnormal (that is to say, quite different from its normal vacuum expectation value) is investigated. It is shown that, if the ϕ^3 coupling is sufficiently large, then such a configuration can be metastable, and its physical size may become substantially greater than the usual microscopic dimension in particle physics. Furthermore, independent of the strength of the ϕ^3 coupling, if $\phi(x)$ has a sufficiently strong scalar interaction with the nucleon field, the state that has an abnormal $\langle\phi(x)\rangle$ inside a very heavy nucleus can become the minimum energy state, at least within the tree approximation; in such a state, the "effective" nucleon mass inside the nucleus may be much lower than the normal value. Both possibilities may lead to physical systems that have not yet been observed. (auth)

31098 (DESY-73-62) PRODUCT STATES FOR LOCAL ALGEBRAS. Buchholz, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1973. 24p. Dep. NTIS (U. S. Sales Only) $4.25.

Let $R(O_1) \subset B(H)$ and $R(O_2) \subset B(H)$ be the von Neumann algebras associated with the space-time regions O_1 and O_2 resp. in the vacuum representation of the free neutral massive scalar field. For suitably chosen spacelike separated regions O_1 and O_2 it is proved that there exists a normal product state φ of $B(H)$, $\varphi(AB) = \varphi(A) \cdot \varphi(B)$ for all $A \in R(O_1)$ and $B \in R(O_2)$. Some consequences for the algebraic structure of the local rings are pointed out. (auth)

31099 (JINR-P2-7585) STATEMENT OF A SCATTERING PROBLEM IN THE BOSON QUANTUM FIELD THEORY SUITABLE IN THE PRESENCE OF BOUND STATES. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

It is shown that Ekstein's statement of the scattering problem in the presence of several scattering channels in the nonrelativistic quantum mechanics can be generalized directly to the case of the boson quantum field theory. A proper choice of asymptotic states is determined. The independent of the Ekstein equations way of the scattering matrix determination is given for the case when more complex states (of the particle type) than one-particle excited states are absent. (auth)

31100 (JINR-P2-7605) UNPREDICTED PROPERTIES OF DEGENERATION OF THE VACUUM OF A SCALAR CHARGED FIELD INTERACTING WITH AN ELECTROMAGNETIC ONE FOR THE CASE OF ONE SPACE AND ONE TIME DEGREE OF FREEDOM. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.25.

In the model considered, a particle of a nonzero rest mass in the case of vacuum degeneration does not decay into the Goldstone bosons. Solutions of the types "degenerated vacuum" and "nondegenerated vacuum" exist simultaneously at one and the same values of mass parameter. Solutions of the first type exist in the model considered without introducing the self-action term $g(\phi^*\phi)^2$ into the Lagrangian, in contrast to other papers where the presence of this term is supposed to be necessary. (auth)

31101 (NP-19895) ASTROPHYSICS AND TACHYONS. Mignani, R.; Recami, E. (Catania Univ. (Italy). Istituto di Fisica Teorica). Oct 1973. 32p. Dep. NTIS (U.S. Sales Only) $3.75.

From the very special relativity theory existence of superluminal reference frames and faster-than-light-objects can be inferred, when its validity is not arbitrarily confined to subluminal velocities. Recently, in fact, special relativity has been straightforwardly extended to superluminal inertial frames and to tachyons thus allowing a sound, self-consistent development of a classical theory of tachyons. The "extended theory of relativity" allows in particular extending the Doppler effect formulas to superluminal sources. The possibilities of radiocontact between subluminal and superluminal objects are as well considered. The behavior of tachyonic bodies in the gravitational field was clarified. Tachyons are predicted to suffer a gravitational repulsion (so to be considered as the "antigravitational matter"); however, owing to their dynamics, they happen finally to behave-from the geometrical and kinematical viewpoint-as usual objects do. At last, the problem of gravitational Cherenkov radiation (GCR) is studied. Contrarily to the previous authors, extended relativity predicts tachyons not to emit GCR in vacuum or in bradyonic (subluminal) media. (auth)

31102 (NP-19899) CLASSICAL THEORY OF TACHYONS (SPECIAL RELATIVITY EXTENDED TO SUPERLUMINAL FRAMES AND OBJECTS). Mignani, R.; Recami, E. (Catania Univ. (Italy). Istituto di Fisica Teorica). Jul 1973. 175p. Dep. NTIS (U.S. Sales Only) $10.75.

A review is given of the classical theory of superluminal objects, where classical means relativistic but not quantum mechanical. The generalization of special relativity to superluminal (inertial) reference frames and tachyons, causal paradoxes, symmetries required by extended relativity for example the crossing relations derived for usual particle scattering are treated. A close link between magnetic monopoles and tachyons is suggested. (JFP)

31103 (ORO-3992-154) S-MATRIX FOR FINITE QUANTUM FIELD THEORY IN THE INTERACTIONS REPRESENTATION. Chiang, C. C. (Texas Univ., Austin (USA). Center for Particle Theory). 1973. Contract AT(40-1)-3992. 15p. (CPT-199). Dep. NTIS $4.00.

Following the theory of shadow states, a unitary S-matrix is constructed in the interaction representation for finite quantum field theory with indefinite metric. The unitarity of the S-matrix is proved. Furthermore, it is shown that the S-matrix in the interaction representation is equivalent to, at least up to second order in perturbation expansion, the S-matrix in Heisenberg representation formulated previously. (auth)

31104 (ORO-3992-175) SCALING AND ASYMPTOTICALLY FREE MASSIVE YANG-MILLS FIELD. (Texas Univ., Austin (USA). Center for Particle Theory). 11 Apr 1974. 5p. (CPT-219). Dep. NTIS $4.00.

It is shown that the renormalizable theory of the massive Yang–Mills field, formulated with the help of a Lagrange multiplier field and without spontaneously broken gauge symmetry, is asymptotically free. This suggests that scaling may be explained in a non-gauge theory. (auth)

31105 (ORO-3992-177) GENERALIZED GAUGE INVARIANCE AND THE ASYMPTOTICALLY FREE THEORY OF MASSIVE YANG–MILLS FIELD. Hsu, J. P. (Texas Univ., Austin (USA). Center for Particle Theory). 1974. 14p. (CPT-221). Dep. NTIS $4.00.

A new concept of gauge invariance for the isovector 4-vector field $\vec{I}_\mu(x)$ with a mass M is proposed. (The mass has nothing to do with spontaneously broken gauge symmetry). Its origin lies in the fact that the spin 0 part of $\vec{I}_\mu$ is unobservable. The Lagrange multiplier field $\vec{\chi}(x)$ is employed in the construction of a "gauge invariant" theory of massive Yang–Mills field. The field $\vec{\chi}$ may have arbitrary mass and different couplings. The theory is renormalizable, unitary, covariant and asymptotically free. The rules for the Feynman diagrams involve a fictitious particle, a new vertex and a free parameter β, where β is the ratio of the square of the mass for $\vec{\chi}(x)$ to M^2. In the limit $M \to 0$, which is well defined, β becomes the usual gauge parameter in the theory of massless Yang–Mills field. Also the limit $\beta \to \infty$ is taken where the S matrix is manifestly unitary. All these come about because dynamics and symmetry are intimately related. (auth)

31106 (ORO-3992-179) FASTER THAN LIGHT PARTICLES AND T-VIOLATION. Vilela Mendes, R. (Texas Univ., Austin (USA). Center for Particle Theory). Dec. 1973. 13p. (CPT-223). Dep. NTIS $4.00.

The properties of the interactions of faster than light particles (tachyons) with ordinary matter are discussed both in the framework of a classical closed causal cycle and in a field theoretical formalism constrained by the reinterpretation principle. It is concluded that such interactions, if they exist, most likely violate time reversal invariance. As a consequence it is suggested that tachyons might play a role in CP-violation. (auth)

31107 CLASSICAL THEORY OF PARTICLES AND FIELDS. Volume I. Introductory Theory. Ruei, K. H. Particles and Fields. Taipei, Taiwan; University Press (1972). 380p. Richard Abel and Co., Inc., Portland, OR, $9.50.

The discussion covers one-particle systems, many-particle systems and rigid bodies, and waves. (JFP)

31108 CLASSICAL THEORY OF PARTICLES AND FIELDS. Volume II. Advanced Theory. Ruei, K. H. Particles and Fields. Taipei, Taiwan; University Press (1972). 447p. Richard Abel and Co., Inc., Portland, OR, $11.50.

The topics discussed are particle systems in the Lagrangian Hamiltonian and Hamilton–Jacobi formulations, special relativity, and fields. (JFP)

31109 CLASSICAL THEORY OF PARTICLES AND FIELDS. Volume III. Electrodynamics. Ruei, K. H. Particles and Fields. Taipei, Taiwan; University Press (1972). 420p. Richard Abel and Co., Inc., Portland, OR, $11.50.

The topics discussed include the basic equations, electro- and magnetostatics, electromagnetic waves, and radiations. (JFP)

31110 QUANTUM THEORY OF PARTICLES AND FIELDS. Volume I. Introductory Theory of Particles. Ruei, K. H. Particles and Fields. Taipei, Taiwan; University Press (1972). 480p. Richard Abel and Co., Inc., Portland, OR, $12.50.

The treatment covers the Schroedinger and action principle formulation, the bound state problem, and scattering theory. (JFP)

31111 QUANTUM THEORY OF PARTICLES AND FIELDS. Volume II. Advanced Theory of Particles. Ruei, K. H. Particles and Fields. Taipei, Taiwan; University Press (1972). 395p. Richard Abel and Co., Inc., Portland, OR, $11.50.

The discussion covers Pauli theory, two identical particles, and relativistic quantum mechanics. (JFP)

31112 ALGEBRAIC THEORY OF LOCAL OBSERVABLES WITHOUT MICROSCOPIC CAUSALITY. Davis, F. I. Waltham, MA; Brandeis Univ. (1973). 101p. University Microfilms Order No. 73-32,375.

Thesis (Ph. D.).

The role of the microcausality postulate, in relation to the postulates describing the local structure and the action of the translation group, in an algebraic theory of local observables is investigated. The translations are analyzed, and it is shown that this automorphism group may be implemented by unitary operators from the ring of observables satisfying the usual spectral conditions. The conventional assumption of strict locality is weakened by assuming that local observables have commutators which decrease to zero as the separation between the regions they are associated with increases in a space-like direction. The theory is studied by deriving anew certain results originally obtained in a framework of strict locality. In particular, it is found that it is possible, using only weak locality assumptions, to construct a vacuum representation, physically equivalent to the original, non-observable charged fields which satisfy either Bose or Fermi statistics asymptotically and scattering states. (Diss. Abstr. Int., B)

31113 ANOMALOUS DIMENSIONS OF HIGHER-ORDER OPERATORS IN THE PHI^4-THEORY. Brezin, E.; De Dominicis, C.; Zinn–Justin, J. (CEN de Saclay, Gif–sur–Yvette, France). Lett. Nuovo Cim.; 9 No. 12, 483-486(23 Mar 1974).

It is shown that for all operators of mass dimension ≤ 4 in 4 dimensions, the only new critical exponent (in addition to η and ν is the exponent ω, though it enters in a quite different context (the scaling region itself). This result applies also in the ϕ^4-field theory in four dimensions if there is an ultraviolet fixed point. (JFP)

31114 CANONICAL DIMENSIONS IN ASYMPTOTICALLY CONFORMAL INVARIANT THEORIES. Ferrara, S.; Testa, M. (CERN, Geneva). Phys. Lett.; 49B: No. 1, 95-98(18 Mar 1974).

It is shown that canonical dimensions in the product of currents near the light-cone imply a free field structure for the Wightman functions of currents in the underlying skeleton theory. (auth)

31115 COUPLING CONSTANTS ARE NOT ARBITRARY IN ASYMPTOTICALLY FREE THEORIES. Salam, A. (International Centre for Theoretical Physics, Trieste, Italy); Strathdee, J. Lett. Nuovo Cim.; 9: No. 12, 464-466(23 Mar 1974).

It is found that the renormalized coupling constants (and possibly also the ratios of the masses) are not free parameters in asymptotically free theories, but instead must be computed self-consistently from unsubtracted dispersion equations of the eigenvalue variety. The case of a self-interacting $g\phi^4$ theory with $g < 0$ is considered. (JFP)

31116 GELL-MANN–LOW FUNCTION IN SINGLE-CHARGE SCALAR QUANTUM FIELD THEORY. Avdeeva, G. M.; Belavin, A. A. (Gorky State Univ., USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 10, 359-362(20 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 10, 611-613(20 Nov 1973).

The first three terms of the Gell-Mann–Low function are obtained in the $\lambda\phi^4$ theory. It is shown that the "zero-charge" situation remains in force when terms up to $\lambda^2[\lambda\ln(\lambda/k)]^4$ are taken into account. (auth)

31117 SPONTANEOUS SYMMETRY BREAKING IN REGGEON FIELD THEORY. Abarbanel, H. D. I. (California Inst. of Tech., Pasadena). Phys. Lett.; 49B: No. 1, 61-62(18 Mar 1974).

A Reggeon field theory when the bare or input Regge intercept α_0 is greater than one is considered. This corresponds to a negative mass squared term in conventional field theory and allows for a spontaneous symmetry breakdown. A theory with Regge intercept at one emerges, restoring the Froissart bound by t-channel considerations alone. In our elementary example the resulting bare trajectory is nearly of the square root variety familiar from s-channel eikonalization of models which violate the Froissart bound. (auth)

31118 LAGRANGIAN MODEL INVARIANT UNDER SUPERGAUGE TRANSFORMATIONS. Wess, J. (Univ., Karlsruhe, Ger.); Zumino, B. Phys. Lett.; 49B: No. 1, 52-54(18 Mar 1974).

A Lagrangian model invariant under supergauge transformations is studied in the one-loop approximation. The model involves a scalar, a pseudoscalar and a spinor field. Supergauge invariance gives rise to relations among the masses and the coupling of these fields and implies the existence of a conserved current. The renormalization procedure is discussed and the relations among masses and couplings are shown to be preserved by renormalization. (auth)

31119 CONVARIANT QUANTUM ELECTRODYNAMICS WITHOUT INDEFINITE METRIC. Brevik, I. (Luftkrigskolen, Trondheim, Norway). Phys. Norv.; 7: No. 2, 51-56(1973).

Remarks are made on a quantization method for the free electromagnetic field recently proposed by Schmutzer. This method has some attractive features: It is covariant (although not manifestly covariant), it permits the Lorentz condition $\partial^\mu A_\mu = 0$, and the metric of the Hilbert space is positive definite. In contrast to the Coulomb gauge method the scalar and longitudinal potential components are not put equal to zero, but retained as c-numbers.

It is shown how it is possible to perform restricted gauge transformations in this formalism, affecting the c-number components only, and the direct analogy between these c-numbers and the scalar and longitudinal photons in the Gupta–Bleuler theory is pointed out. Covariance properties of the method are discussed. (auth)

31120 RECONSTRUCTION OF NON-LOCAL FIELD THEORY. 1. Causal Description. Sogami, I. (Kyoto Sangyo Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 5, 1729-1747(Nov 1973).

An attempt is made successfully to refine the non-local field theory in a manifestly causal and covariant way. The motion of the non-local system as a whole is described on the viewpoint of the action through medium and considered to be governed by causal laws. On the other hand the internal motion of the system is treated on the action at a distance and regarded as being free from causal restrictions in the field theoretical sense. The form of interaction of bilocal field is assumed to be local with respect to external variables. The quantization is carried out after the Yang–Feldman method and elements of a unitary S-matrix are defined as the sole kind of physical observables. The theory thus constructed, being just one of the field theoretical formulation of the quark model, seems to be suitable for an overall description of phenomena including hadrons. (auth)

31121 GAUGE FIELDS AS BOUND STATES. Budini, P. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 9: No. 13, 493-500(30 Mar 1974).

It is shown that the hypothesis that bound states are generated by weak interactions between leptons might be at the origin of Yang–Mills gauge fields; and it is shown how the Abelian or non-Abelian gauge transformations of the gauge fields might be due to that of the constituent spinor fields when the Wilson short-distance behavior of the spinor field representing the constituent leptons is considered. (JFP)

31122 LAGRANGIAN FIELD THEORY FOR MASSIVE ARBITRARY SPIN PARTICLES. Foster, V. G. H. Clemson, SC; Clemson Univ. (1973). 96p. University Microfilms Order No. 74-3911.

Thesis (Ph.D.).

A Lagrangian field theory describing massive arbitrary spin particles based only on the assumptions of the quantum action principle and relativistic invariance was developed. This theory provides a consistent derivation of both free field equations and interacting field equations without any additional assumptions. By utilizing the general aspect of this theory, it was shown that operator transformations are dependent on the subsidiary conditions of the higher spin fields, that interacting field theories are dependent on the form of these subsidiary conditions, and that interaction Lagrangians must be symmetric. Explicitly generalized Lagrangians were constructed for both integer and half-integer spin fields. It was shown that these Lagrangians lead through the operator action principle to the field equations and subsidiary conditions. The free field theory resulting from applying the operator action principle to these Lagrangians was developed explicitly. The interacting field equations for massive charged particles were derived. Finally, nonelectromagnetic interactions were considered by using general forms of the interaction Lagrangian and the interaction field equations were derived. (Diss. Abstr. Int., B)

31123 NEW INTERPRETATION OF THE EUCLIDEAN–MARKOV FIELD IN THE FRAMEWORK OF PHYSICAL MINKOWSKI SPACE-TIME. Guerra, F.; Ruggiero, P. (Univ., Salerno, Italy). Phys. Rev. Lett.; 31: No. 16, 1022-1025(15 Oct 1973).

The Euclidean-Markov field, extensively used in constructive quantum field theory, is shown to be the same as the lowest energy generalized stochastic process associated with classical field theory through the procedure of Nelson's stochastic mechanics. As a result, the underlying four-dimensional manifold, on which the Markov field is defined, can be considered as the physical space-time. (auth)

Gravitation and General Relativity

Refer also to abstracts 30576, 31101, and 31123.

31124 (JINR-E2-7684) THEORY OF DYNAMICAL AFFINE AND CONFORMAL SYMMETRIES AS GRAVITY THEORY. Borisov, A. B.; Ogievetsky, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 24p. Dep. NTIS (U. S. Sales Only) $4.25.

The invariance with respect to the infinite-dimensional general covariance group is equivalent to the invariance with respect to the affine and conformal groups simultaneously. The nonlinear realizations of affine group (the Poincare group being the stability subgroup) lead to the symmetry tensor field as the Goldstone field. The requirement that the theory also corresponds at the same time to the realizations of conformal group, results uniquely in the tensor field theory which equations coincide with the Einstein equations. Thus, it becomes clear that the theory of gravitation is that of spontaneous breaking of the affine and conformal symmetries, just as the chiral dynamics is the theory of the spontaneous breaking of the chiral symmetry. The analogy established suggests some new aspects of possible gravity effects in elementary particle physics. (auth)

31125 VECTOR–METRIC THEORY OF GRAVITY. Hellings, R. W. Bozeman, MT; Montana State Univ. (1973). 119p. University Microfilms Order No. 74-2062.

Thesis (Ph. D.).

A new theory of gravity is presented in which gravity is produced by a massless vector field in addition to the usual metric field. It is found that the theory is compatible with present solar system experiments and cosmological observations. The theory also predicts the existence of black holes and of the most general types of weak plane waves. (Diss. Abstr. Int., B)

31126 HAMILTONIAN STRUCTURE OF SPACETIME. Weitzman, C. T. Princeton, NJ; Princeton Univ. (1973). 118p. University Microfilms Order No. 74-2363.

Thesis (Ph. D.).

An alternative approach to general relativity is presented in which the central mathematical concept is the deformation of a hypersurface embedded in a Riemannian manifold. The main motivation is the idea that space-time should not be a concept built in at a fundamental level but it should be, rather, derived from the theory. "Embeddability" or "path independence" conditions which ensure the existence of space-time are found. If they are not satisfied, the evolution of a 3-geometry cannot be viewed as the "motion" of a three-dimensional cut in a four-dimensional space-time. These conditions are precisely the Poisson bracket relations between the Hamiltonian generators obtained in a different way by Dirac, when dealing with "parametrized field theories" in Minkowski space. This work is more general for it does not assume that the Hamiltonian constraints can be solved to express four of the momenta in terms of the remaining canonical variables. The embeddability conditions are used to arrive directly at the Hamiltonian form of general relativity without ever using a Lagrangian or any other four-dimensional quantity. When one studies couplings to matter, path independence forces one into gauge invariance and leads naturally to Maxwell's equations (also in Hamiltonian form). The results apply to a space-time of arbitrary dimension and of signature $(+, \ldots\ldots +, -)$ or $(+, +, \ldots\ldots, +)$. The work is nonquantum throughout. (Diss. Abstr. Int., B)

31127 CHOICE OF THE GRAVITATIONAL-FIELD VARIABLE IN ELECTROMAGNETIC SELF-ENERGY PROBLEMS. Guerses, M. (Middle East Technical Univ., Ankara). Nuovo Cim.; 20A: No. 2, 363-372(21 Mar 1974).

$K^{\mu\nu} = \sqrt{-g}g^{\mu\nu}$ is chosen as a field variable for gravitation. The effective part of the graviton superpropagator is calculated and applied in the electromagnetic self-energy problems. It is found that the longitudinal part of the polarization tensor vanishes in the flat space and the renormalized electron mass and charge are finite. (auth)

31128 VARIATIONAL PRINCIPLES TO OBTAIN EQUATIONS OF MOTION FOR NONLINEAR GRAVITATIONAL THEORIES. Cavalleri, G. (CISE, Milan); Spinelli, G. Lett. Nuovo Cim.; 9: No. 8, 325-330(23 Feb 1974).

The Kalman method is generalized to find the equations of motion in general unrenormalized co-ordinates. The problem of finding the corresponding metrics of the curved space in which the same motion is described as a geodetic line is solved at the second order in the gravitational coupling constant. (LBS)

31129 ELECTROMAGNETIC FIELDS IN GENERAL RELATIVITY: A CONSTRUCTIVE PROCEDURE. Cohen, J. M.; Kegeles, L. S. (Univ. of Pennsylvania, Philadelphia). Phys. Lett., 47A: No. 3, 261-262(25 Mar 1974).

A new procedure for obtaining explicit solutions to Maxwell's equations in curved spaces is presented. The problem is reduced to solving one linear scalar wave equation. The formulation includes astrophysically important cosmological models, neutron star and black hole space-times. (auth)

31130 REST FRAME IN STATIONARY SPACETIMES WITH AXIAL SYMMETRY. Greene, R. D. New York; New York Univ. (1973). 77p. University Microfilms Order No. 74-1896.

Thesis (Ph.D.).

The general problem of defining spaces of simultaneity is

discussed, as is the dragging of inertial frames. The disadvantages of the Killing frame in a stationary, axially-symmetric space time are pointed out, with specific examples from the Kerr metric. Also, the existence of an infinite-redshift surface, where the Killing frame breaks down, outside of a black hole is demonstrated. The problem of finding a frame which eliminates all these difficulties is considered. A rest frame is defined as a synchronizable frame which is as nearly Killing as possible. This would be the generalization of the Newtonian rest frame. Bardeen's local nonrotating frame, for the case of orthogonal transitivity, is discussed and shown to be a possible rest frame. A kinematical theorem giving the condition for the existence of a rest frame whose time vector is a linear combination of the Killing vectors is then proved. The frame is also unique. The condition is shown to be weaker than the assumption of orthogonal transitivity. The surfaces of simultaneity of the rest frame are the surfaces of constancy of a particular Killing time coordinate, and its time vector is the component of the time Killing vector orthogonal to the angular Killing vector. Some properties of the rest frame are then discussed; it is shown that the frame is well behaved down to the event horizon. Finally, the three-vector potential of Landau and Lifshitz is interpreted and shown to be closely related to the rest frame, and a corresponding four-vector potential is invariantly defined. (Diss. Abstr. Int., B)

31131 APPLICATIONS OF THE G_4IV ISOMETRY GROUP TO EINSTEIN'S EQUATIONS. Foster, J. C. Jr. Clemson, SC; Clemson Univ. (1973). vp.

Thesis (Ph. D.).

Since the formulation of the general theory of relativity in 1916 by A. Einstein, one of the most prominent problems associated with the theory has been finding exact solutions to the field equations. The first exact solution was found by Schwarzschild in 1916. Since that time a large number of solutions have been found for various cases of high symmetry. The problem of understanding the various symmetries has led to investigations which begin with a symmetry group and proceed towards an exact solution and thus an understanding of the relation between the symmetry groups, called Lie groups of motion, and Einstein's equations. Such an investigation is made. One begins with the group of motions classed G_4IV by Petrov and makes the particular choice of requiring the group of motions to act multiply-transitive on three-dimensional time-like hypersurfaces. Applying this symmetry to Einstein's equations with a dust source a world model is found which admits particles which have space-like four-velocities. In fact, the dust is required to travel only in space-like directions with no normal matter present in the world model. These solutions are interpreted in accordance with recent investigations concerning faster-than-light particles. Furthermore, the same symmetry restriction are applied to Einstein's field equations for the vacuum field case and the electrovac case. These investigations indicate that the symmetry which is compatible with a tachyon dust is incompatible with both vacuum fields and electrovac type fields. It is the opinion that further investigations with this particular symmetry applied to various other sources might be of interest. In particular the results of the problem of a charged dust might be of interest to researchers presently engaged in experiments to detect tachyons. (Diss. Abstr. Int., B)

31132 GRAVITATION. Misner, C. W.; Thorne, K. S.; Wheeler, J. A. San Francisco; W. H. Freeman and Company (1973). 1295p. $19.95.

The material on gravitation physics (Einstein's general relativity or geometrodynamics) is presented in two parallel tracks in an attempt to divide key physical ideas from more complex enrichment material. The laws of physics in flat space-time, Einstein's geometric framework for physics, applications with pulsars and neutron stars, cosmology, the Schwarzschild geometry and gravitational collapse, gravitational waves, experimental tests of Einstein's theory, and mathematical concepts of differential geometry are treated. (IAA)

REACTOR TECHNOLOGY AND REGULATION

31133 (CONF-730465-) INTERNATIONAL SYMPOSIUM ON VIBRATION PROBLEMS IN INDUSTRY. Proceedings of a Symposium Held in Keswick, England, 10–12 Apr 1973. (UKAEA). [nd]. vp. UKAEA.

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Eighty papers were presented, the broad topics being basic fluid dynamics data, acoustic vibration problems, heat exchanger problems, gas-cooled reactor problems, specific approaches to vibration problems, structural response, analysis and techniques. There were six sessions and papers and discussions from each are published as separate volumes. Abstracts were prepared for thirty-eight papers of interest in the nuclear field. (UK)

For abstracts of individual papers see: 29237–29241, 31158, 31159, 31172–31186, 31198–31200, 31209–31215, 31252, 31376, 31391–31393, and 31407.

31134 (INIS-mf-999) ANNUAL REPORT 1972. (Stichting Reactor Centrum Nederland, The Hague). 1973. 92p. (In Dutch). INIS.

Information is presented concerning water cooled reactor development, isotope separation, SNR reactor components testing and physics measurements, gas-cooled breeder reactor development, radioactive waste disposal, and research reactor programs. (DCC)

31135 (TID-3339-P1-1) GAS-COOLED REACTOR TECHNOLOGY. A Bibliography (Part 1). Rushing, J. W. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Apr 1974. 191p. Dep. NTIS $7.60.

Abstracts containing information on gas cooled reactors found in NSA Volumes 1 through 15 are presented. Volume and abstract number, title, author, corporate author, report number or journal source, publication date, and other information are included in the citations. (JWR)

31136 (TID-3339-P1-2) GAS-COOLED REACTOR TECHNOLOGY. A Bibliography (Part 1-Index). Rushing, J. W. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Apr 1974. 22p. Dep. NTIS $4.00.

The NSA subject indexing for all citations in Part 1 is presented. (JWR)

31137 (TID-3339-P2-1) GAS-COOLED REACTOR TECHNOLOGY. A Bibliography (Part 2). Norris, J. W. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Apr 1974. 372p. Dep. NTIS $10.60.

Abstracts containing information on gas cooled reactors found in NSA Volumes 16 through 20 are presented. Volume and abstract number, title, author, corporate author, report number or journal source, publication date, and other information are included in the citations. (JWR)

31138 (TID-3339-P2-2) GAS-COOLED REACTOR TECHNOLOGY. A Bibliography (Part 2-Index). Norris, J. W. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Apr 1974. 106p. Dep. NTIS $5.45.

The NSA subject indexing for all citations in Part 2 is presented. (JWR)

31139 V FORATOM CONGRESS, FLORENCE, OCTOBER 15–17, 1973. Com. Naz. Energ. Nucl., Notiz.; 19: No. 12, 27(Dec 1973). (In Italian).

Separate abstracts were prepared for the six papers included. (JWR)

For abstracts of individual papers see: 31140–31144, and 31370.

31140 DESIGN AND CONSTRUCTION EXPERIENCE WITH OPERATING NUCLEAR POWER PLANTS. Tupini, G. Com. Naz. Energ. Nucl., Notiz.; 19: No. 12, 28-35(Dec 1973). (In Italian).

From fifth Foratom congress; Florence, Italy (15 Oct 1973).

The principal considerations leading to the choice of a nuclear power plant rather than a conventional one are outlined. The various type of construction and operating licenses required in different countries are discussed. The primary causes for construction delays are given. The industrial structure imposed on the development of the nuclear sector is described. (JSR)

31141 COMMERCIAL OPERATING EXPERIENCE. Speri, G. Com. Naz. Energ. Nucl., Notiz.; 19: No. 12, 36-45(Dec 1973). (In Italian).

From fifth Foratom congress; Florence, Italy (15 Oct 1973).

A synthesis is presented of the commercial operating experience acquired from the operation of 32 nuclear power plants in 9 Foratom countries. The behavior of the plants are discussed. Particular experience obtained with light water reactors and gas-graphite reactors is considered. Problems encountered with the fuel are summarized. Safety and environmental aspects in the operation of nuclear power plants are considered. (JSR)

31142 PROGRESS IN THE FIELD OF DESIGN AND CONSTRUCTION. Franco, G. Com. Naz. Energ. Nucl., Notiz.; 19: No. 12, 46-51(Dec 1973). (In Italian).

From fifth Foratom congress; Florence, Italy (15 Oct 1973).

Design and construction problems connected with the selection of the site are outlined. The principal criteria, codes, and standards for the design of power plants are cited. The deficiencies in the supply of component parts by industry are discussed. Cost factors are briefly considered. (JSR)

31143 FUTURE OF INDUSTRIAL DEVELOPMENT. Sette, P. Com. Naz. Energ. Nucl., Notiz.; 19: No. 12, 64-67(Dec 1973). (In Italian).

From fifth Foratom congress; Florence, Italy (15 Oct 1973).

The primary factors leading to the development of nuclear power are outlined. The types of reactors of primary interest for power plants are cited. Uranium availability is considered. (JSR)

31144 JOINT ROLE OF PROVEN, ADVANCED, AND FAST BREEDER REACTORS. Angelini, A. M. Com. Naz. Energ. Nucl., Notiz.; 19: No. 12, 68-75(Dec 1973). (In Italian).

From fifth Foratom congress; Florence, Italy (15 Oct 1973).

The probable development of nuclear power plants in western Europe is outlined. The characteristics and economic factors in the use of proven, advanced, and fast breeder reactors in nuclear power plants are considered. (JSR)

31145 DEVELOPMENT OF STANDARDIZATION IN NUCLEAR ENERGY. Santarelli, E. Com. Naz. Energ. Nucl., Notiz.; 20: No. 1, 57-62(Jan 1974). (In Italian).

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 30776, 31354, 31371, 31414, 31431, 31432, and 31437.

31146 (DOCKET-50263-339) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Six-Month Operating Report No. 6, July–December 1973. (Northern States Power Co., Minneapolis, Minn. (USA)). 28 Feb 1974. 89p. Dep. NTIS $7.50.

An operations summary including chronological history, changes in plant design, performance characteristics, procedure changes, results of surveillance tests and inspections, containment leak rate tests, organizational changes and occupational personnel radiation exposures is provided. Power generation statistics, shutdowns, maintenance activities, radioactive effluent releases, and environmental monitoring are presented. (FS)

31147 (EUR-5074) GUNDREMMINGEN (KRB) NUCLEAR POWER PLANT. Annual Report, 1972. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen/Guenzburg (F.R. Germany)). 1974. Contract 005-63-4 REPD. 95p. (In German). Dep. NTIS (U.S. Sales Only) $7.75. FB 125,-.

As in previous years, the power plant was operated continuously in 1972 at full rated power. The summer shutdown took two months, because of a complete turbine overhaul. Nonetheless, with a plant availability over the 1972 period of 82.7%, 1 820 GWh were generated. Of the 17.3% non-availability, turbine overhaul accounted for 16.9% and plant outages owing to breakdowns for the remaining 0.4%. In 1972, 356 outside personnel, in addition to the KRB's own 107 personnel, were employed and monitored. The radiation burden of the KRB personnel was 268 rem and that of the outside personnel 175 rem. The increase over 1971 was mainly caused by high-activity repair work. Only a few days after plant startup, the concentration of radioactive fission products in the reactor water rose unusually quickly. Right at the beginning of the fifth cycle, the iodine-131 activity concentration was higher than at the end of the fourth cycle, and by the end of 1972 had reached 10^{-1} μCi/ml. Major fuel element damage must be held responsible for this development. (auth)

31148 (GU-5304) DRESDEN 1 PLUTONIUM RECYCLE PROGRAM. Semiannual Report for Period Ending June 30, 1973. Krysinski, J. L.; Wan, M. (Gulf United Nuclear Fuels Corp.,

Elmsford, N. Y. (USA)). Jul 1973. Contract AT(11-1)-2210. 49p. Dep. NTIS $4.50.

The overall program to date is summarized. A summary of reactor operations and calculational predictions with emphasis on those parameters which might be affected by the mixed-oxide assemblies is presented. Power and exposure histories for each mixed-oxide assembly are included. Since no fuel inspections were performed on the 11 mixed-oxide assemblies during this report period, the fuel inspection section has been omitted. Comparisons between the measured copper wire activation for in-core instrument calibration and the calculated activation for the plutonium instrumented assemblies are presented. A description of the calculational model and the wire activation procedures are discussed along with several wire comparisons from both Cycles 7 and 8. The plans and schedule for the remainder of the program are given. 8 references. (auth)

31149 (INIS-mf-1142) DETECTION OF SECONDARY STEAM GENERATOR TUBE LEAKS IN BOILING WATER REACTOR BY RADIOCHEMICAL MEASUREMENTS. Nandwani, T. B. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The Secondary Coolant in PWRs and CANDU type reactors does not normally contain radioactivity. In such power plants, the presence of radioactivity in Secondary Coolant indicates primary to secondary leakage. Soluble nuclides like Na-24 can then be utilized to calculate the leak rate. The situation with dual cycle boiling water reactors (BWRs) is entirely different since the water in secondary steam generators (SSGs) also contains radioactivity. The condensate and secondary feed carry radioactivity through the steam cycle. At Tarapur Atomic Power Station (TAPS), the radioactivity concentrations of water in SSGs during operation with leaky fuel have been observed to be as high as 50% of that of reactor water. Small leaks in SSGs go unnoticed by control room instruments and under above conditions they can go undetected by routine radiochemical measurements. The methods adopted at TAPS to detect such leaks are discussed. By reducing secondary feed and/or taking it through demineralizers, the radioactivity input from steam cycle was reduced. Presence of ^{99}Mo-^{99m}Tc in gamma spectra (0.14 MeV peak) of samples from one of the SSGs confirmed the leakage present in its tubes. Specific methods were developed to find out the leak rate by following build-up rate of fission products ^{131}I and ^{99}Mo-^{99m}Tc in SSGs water. This was followed up by hydrostatic pressure testing during next extended outage which confirmed the leaks once again. (auth)

31150 (NEDO-10958) GENERAL ELECTRIC BWR THERMAL ANALYSIS BASIS (GETAB): DATA, CORRELATION AND DESIGN APPLICATION. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Nov 1973. 176p. (73-NED-9).

Since the introduction of the Hench-Levy Design Limit Lines in 1966, General Electric has continued to perform an extensive boiling transition test program, and there have been numerous and extensive advancements in both experimental and analytical methods of investigating and correlating the occurrence of transition boiling. Improvements in technology now allow accurate full-scale prototypic simulation of reactor fuel assemblies operating under conditions duplicating those in actual reactor designs. The data obtained provide a direct demonstration giving complete assurance of boiling water reactor (BWR) heat transfer performance. These advancements, the greatly expanded data base, and an improved method of correlating the data provide the impetus for introducing a new boiling heat transfer design basis. The new design basis is presented in its entirety, including the boiling transition correlation, the data base, the prediction capabilities, and the application to BWR thermal design. (22 references) (auth)

31151 (SRARI-P-199) REVIEW OF THE BASIC RESULTS OF THE STUDY OF THE STATE OF STANDARD FUEL ELEMENTS OF WATER-COOLED POWER REACTORS. Votinov, S. N.; Belokolytov, V. S.; Davydov, E. F.; Mayershin, A. A.; Pakhomov, Z. I.; Andreeva, A. B. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 28p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.50.

Presented are the investigation results on the state of fuel elements in standard subassemblies of the reactor BB P-1. The change in the mechanical properties of cladding at various testing temperatures as well as structural changes due to the irradiation dose are shown. The effects of low temperature annealings on the mechanical properties and the structure of the irradiated alloy have been investigated. The results of radiochemical analysis of the fuel have been presented. The behavior of failed fuel elements has been estimated. A high operational reliability of fuel element cladding of Zr–1% Nb alloy has been indicated. (auth)

31152 (TID-26543) FIFTH MECHANIZED ULTRASONIC INVESTIGATION OF A LAMINAR INDICATION IN THE PLACE OF THE LA CROSSE BOILING WATER REACTOR PRESSURE VESSEL. Topical Report No. 15. (Southwest Research Inst., San Antonio, Tex. (USA)). Sep 1973. Contract AT(11-1)-2154. 48p. Dep. NTIS $5.50.

In April 1973, Southwest Research Institute (SwRI), Department of Special Engineering Services, performed the fifth ultrasonic mapping examination of the LaCrosse Boiling Water Reactor (LACBWR) Plant. Specifically, the area of interest was the lamination area in the wall of the reactor pressure vessel near Recirculation Outlet Nozzle No. 1. The remote-operated scanning device which was specially designed and constructed for this examination was utilized. The intent of this examination was to determine if the lamination in the reactor pressure vessel had propagated by comparing this examination result with those of the previous years. (auth)

31153 (WASH-1203-73) OPERATING HISTORY OF U. S. NUCLEAR POWER REACTORS. (USAEC Division of Reactor Development and Technology, Washington, D. C.). 1973. 83p. Dep. NTIS $5.45.

The information assembled highlights the operating history of U. S. nuclear power plants through December 31, 1973. Included are those nuclear reactor facilities which produce electricity, even if in token amounts, or which are part of a development program concerned with the generation of electricity through the use of a nuclear reactor as a heat source. The charts are plotted in terms of cumulative thermal energy as a function of time. Since only those shutdowns of five days or more are shown, the charts do not give a detailed history of plant operation. They do, however, give an overview of the operating history of a variety of developmental and experimental nuclear power reactors. The data presented in the tables shows the yearly gross generation of electricity for each U. S. nuclear plant and, for civilian power plants, information on reactor availability and plant capacity factor. (auth)

31154 NEUTRON EMBRITTLEMENT SURVEILLANCE OF THE GARIGLIANO REACTOR VESSEL STEEL. Galliani, M. (Ente Nazionale per l'Energia Eletrica, Rome); Serpan, C. Z. Nucl. Eng. Des.; 26: No. 2, 313-325(1974).

The effects of neutron radiation on the pressure vessel of the Garigliano Nuclear Power Station have been analyzed on the basis of results of a reactor vessel material surveillance program of the plant. A high radiation embrittlement sensitivity was determined for the weld metal and for the A336 forging steel of the ring forging course just above the level of the fuel core. Both showed high copper and phosphorus contents, which accounted for the embrittlement sensitivity. The ring forging opposite the fuel core had a low copper and phosphorus content and revealed relatively low embrittlement. A neutron fluence of 6.3×10^{19} n/cm >1 MeV was determined for the peak flux plane for 40 yr of operation. However, the 40 yr fluence for the ring forging at the top of the core level (3.5×10^{19} n/cm >1 MeV) resulted in the highest final transition temperature because of the sensitivity of this steel. The measured Charpy-V shelf energy absorption values were plotted against yield stress values for comparable irradiations on the ratio analysis diagram (RAD). The analysis revealed that the pressure vessel steel properties would continue to degrade toward a condition of possible frangibility at the end of its life. This projection is based on an assumption of uniform embrittlement throughout the vessel wall thickness. Such uniformity does not exist; in fact, a sharp gradient exists in the steel such that ductility rises rapidly in the steel toward the outside wall as well as above and below the fuel core. Hence, because of this strong ductility gradient, the Garigliano reactor vessel should be able to operate safely over its intended design lifetime. 15 references. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 31151, 31153, 31350, 31351, 31354, and 31433–31435.

31155 (ANCR-1144) EXPERIMENT DATA REPORT FOR 1½-LOOP SEMISCALE SYSTEM ISOTHERMAL TESTS 1004 AND 1006. Alder, R. S.; Feldman, E. M.; Pinson, P. A. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Mar 1974. Contract AT(10-1)-1375. 88p. Dep. NTIS $5.45.

Recorded test data are presented for Tests 1004 and 1006 of the isothermal portion of the Semiscale Blowdown and Emergency Core Cooling (ECC) Project. These data represent the results of the first tests in the isothermal test series in which simulated ECC injection during blowdown was investigated. The data, presented in the form of composite graphs in engineering units, have been

analyzed only to the extent necessary to assure that they are reasonable and correct. The intent of this report is to make available the uninterpreted data from Tests 1004 and 1006 for use by others and for support of subsequent interpretative reports and analyses. (auth)

31156 (ANCR-1145) EXPERIMENT DATA REPORT FOR 1½ LOOP SEMISCALE SYSTEM ISOTHERMAL TESTS 1008 AND 1010. Alder, R. S.; Feldman, E. M.; Pinson, P. A. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Mar 1974. Contract AT(10-1)-1375. 75p. Dep. NTIS $5.45.

Recorded test data are presented for Tests 1008 and 1010 of the isothermal portion of the Semiscale Blowdown and Emergency Core Cooling (ECC) Project. These data represent the results of the first isothermal tests utilizing an enlarged downcomer gap (1.0 inch) in the pressure vessel to investigate general system hydraulic response both with and without simulated ECC injection. The data, presented in the form of composite graphs in engineering units, have been analyzed only to the extent necessary to assure that they are reasonable and correct. (auth)

31157 (CENPD-80(Rev.1)(Supp.1 and 2)) MOISTURE CARRYOVER DURING AN NSSS STEAM LINE BREAK ACCIDENT. Supplements 1 and 2. (Combustion Engineering, Inc., Windsor, Conn. (USA). Nuclear Power Dept.). Feb 1974. 21p.

The determination of the amount of moisture carryover expected during a nuclear steam generator steam line break incident and the effect of this carryover on fuel damage probability are analyzed. The specific objective of the test program is to determine the moisture carryover versus time as a function of discharge area and initial water level for the high pressure test facility which contains a steam water separator and steam dryer. Attainment of this objective requires the measurement of thermo-hydraulic parameters during a simulated steam line break test. Moisture carryover fractions ranging from 0 to 70% were measured during the tests. The variation in moisture carryover fraction is due to variations in (1) the initial water level in the test vessel and (2) discharge area of the blowdown line. The results of this test program provide time-dependent temperature and pressure data for comparison with the results of the analytical model used to model the test vessel blowdown. 5 references. (auth)

31158 (CONF-730465-, pp vp. V. 5, Paper 527) EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF FLOW-INDUCED VIBRATIONS IN NUCLEAR COMPONENTS OF PWR. Oesterle, B. (Technische Univ., Munich); Kim, J. D.; Stoelben, H. [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

By means of vibration measurements and the linear system theory, a model is set up for the pre-determination and continuous control of the dynamic stress of vibration-induced components in PWRs during normal operation. The work is based on extensive cold and hot functional tests, i.e., preoperational tests performed at the STADE Nuclear Power Plant, where motion signals of reactor components and pressure signals of the coolant during different phases of their setting up were measured. These measurements and theoretical investigations resulted in a simplified presentation of the system, as a double pendulum consisting of pressure vessel and core barrel, where both pendula are coupled mechanically and hydraulically. The formation of this mechanical and hydraulic vibration model as well as different assumptions on vibration damping and vibration excitation are discussed and compared with measurements resulting from the preoperational tests. (auth)

31159 (CONF-730465-, pp vp. V. 6, Paper 623) SURVEILLANCE OF PWR INTERNALS VIBRATIONS BY MEANS OF PRESSURE TRANSDUCERS. Possa, G.; Rossini, T.; Vanoli, G. (CISE, Milan). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

A new technique is presented for in-service monitoring of pressure vessel internals. It is based on the analysis of the pressure noise of a PWR primary circuit. The aim of the analysis is the identification of pressure oscillations originating from vibrations of structural components placed inside the pressure vessel. The tests were performed at Trino PWR. Two piezoelectric pressure transducers were installed on the primary circuit, at the end of instrumentation lines of two opposite primary loops. The pressure noise was recorded and analyzed at regular time intervals for about two years in a great variety of plant conditions. In the frequency range of interest i.e., below 30 Hz, the pressure noise spectra presented sharp peaks at the characteristic frequencies of the primary pumps and of the charging pump. Broad peaks, due to pendular pressure oscillation, which can be caused by lateral oscillation of the core barrel, were also present. Reactor power did not show any influence on pressure noise. Pressure noise spectra were well reproducible and strongly dependent on number of functioning primary pumps. Pressure noise analysis was also found capable of detecting impacts of free metallic pieces conveyed by primary water against primary walls. (UK)

31160 (DOCKET-50266-144) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Semi-Annual Operation Report No. 7, July 1, 1973–December 31, 1973. (Wisconsin Electric Power Co., Milwaukee (USA)). 1 Mar 1974. 84p. (DOCKET-50301-132). Dep. NTIS $6.25.

Unit 1 was base loaded at 480 MW(e) until September 21, 1973 after which it was operated on load follow for the rest of the year. Load reductions to 75% power were made weekly to conduct routine governor and stop valve tests. For this period, the unit operated at an average 86.33% capacity factor with a net efficiency of 30.48%. The percentage unit and reactor availability were 95.33% and 97.55%. Unit 2 operated on load follow up to September 21, 1973 after which it was placed on base load at full power. Load reductions to 75% power were conducted on a biweekly basis for turbine governor and stop valve testing. Summaries are presented concerning maintenance, instrumentation and control, chemistry, health physics and safety, abnormal occurrences, and design changes, plant performance, and nonradiological environmental monitoring. (FS)

31161 (EUR-5072) OBRIGHEIM NUCLEAR POWER PLANT. Annual Report, 1972. (Kernkraftwerk Obrigheim G.m.b.H., Obrigheim/Mosbach (F. R. Germany)). 1974. 88p. (In German). Dep. NTIS (U. S. Sales Only) $7.50. EUR FB 125.-.

As in previous years, the power plant was operated continuously in 1972 at full rated power. The summer shutdown took two months, because of a complete turbine overhaul. Nonetheless, with a plant availability over the 1972 period of 82.7%, 1 820 GWh were generated. Of the 17.3% non-availability, turbine overhaul accounted for 16.9% and plant outages owing to breakdowns for the remaining 0.4%. In 1972, 356 outside personnel, in addition to the KRB's own 107 personnel, were employed and monitored. The radiation burden of the KRB personnel was 268 rem and that of the outside personnel 175 rem. The increase over 1971 was mainly caused by high-activity repair work. Only a few days after plant startup, the concentration of radioactive fission products in the reactor water rose unusually quickly. Right at the beginning of the fifth cycle, the iodine-131 activity concentration was higher than at the end of the fourth cycle, and by the end of 1972 had reached 10^{-1} μCi/ml. Major fuel element damage must be held responsible for this development. (auth)

31162 (WCAP-3385-37) SAXTON PLUTONIUM PROJECT QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING SEPT. 30, 1973. Crain, H. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Fuel Div.). Dec 1973. 50p. Dep. NTIS $4.00.

Isotopic compositions and burnup of Core III fuel in the Saxton Reactor were determined. Measured isotopic buildups and depletions were compared with calculated values. (JWR)

31163 (WCAP-8185(Amend. 2)) REFERENCE CORE REPORT 17 × 17, AMENDMENT 2. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). 7 Mar 1974. 139p.

Revised information is presented concerning the 17 × 17 fuel assembly design. Significant changes are in regard to a revised control rod drop time based on recent test results and procedures of power distribution control. The information presented has multi-plant application. (auth)

31164 (WCAP-8185(Amend.3)) REFERENCE CORE REPORT 17 × 17, AMENDMENT 3. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 9 Apr 1974. 437p.

Information on the Westinghouse PWR 17 × 17 fuel assembly is presented concerning thermal-hydraulic analysis, safety aspects, and technical specifications. (DCC)

31165 (WCAP-8261) WFLASH: A FORTRAN-IV COMPUTER PROGRAM FOR SIMULATION OF TRANSIENTS IN A MULTI-LOOP PWR. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Feb 1974. 199p.

WFLASH is a computer program for the simulation of reactor plant transients. The program is described and the models and numerical solution of the governing conservation equations used are presented. The engineering aspects of PWR's are included in the component models making up the system. A sample problem, complete with input and output descriptions, is included to facilitate the use of the program. (18 references) (auth)

31166 (WCAP-8297) EFFECT OF 17 × 17 FUEL ASSEMBLY GEOMETRY ON DNB. Hill, K. W.; Motley, F. E.; Cadek, F. F.; Wenzell, A. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Mar 1974. 108p.

A series of tests was run in which the DNB heat flux was determined in axially uniform heated rod bundles of both 17 × 17 (.374" rod) and 14 × 14 (.422" rod) reactor fuel assembly geometry. The purposes of this test series were (1) to assess the DNB performance of .374" fuel rod assembly design, (2) to verify the present design DNB methods for .374" rod geometry and (3) to obtain a body of data which will later be used to develop a new correlation. (10 references) (auth)

31167 (WCAP-8299) EFFECT OF 17 × 17 FUEL ASSEMBLY GEOMETRY ON INTERCHANNEL THERMAL MIXING. Motley, F. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Mar 1974. 46p.

A test to determine the value of the thermal diffusion coefficient (TDC) in the 17 × 17 fuel assembly geometry was conducted. The test section was a 5 × 5 rod bundle with a radial power difference of 4.5 to 1. The rod OD and pitch are identical to the 17 × 17 fuel assembly, as is the mixing vane grid design. Test fluid conditions were varied over a range similar to those found in reactor cores. The value of thermal diffusion coefficient (TDC) was determined by matching the experimental exit enthalpy distribution to that predicted by the THINC computer code. The mean value of TDC for the 17 × 17 fuel assembly geometry is $\overline{TDC}$ = .059. The value of TDC is independent of Reynolds number, mass velocity, pressure, and quality. No difference was found between single and two phase data. An increase in the value of TDC above the present design value is justified. (6 references) (auth)

31168 SINGLE-PHASE SUBCHANNEL MIXING IN A SIMULATED NUCLEAR FUEL ASSEMBLY. Castellana, F. S.; Adams, W. T.; Casterline, J. E. (Columbia Univ., New York). Nucl. Eng. Des.; 26: No. 2, 242-249(1974).

Single-phase subchannel mixing data were obtained from a 25 rod square array by measuring precisely subchannel exit temperatures over a range of test conditions. A least-squares type statistic operating on exit enthalpy differences was developed to ascertain, in conjunction with the COBRA-II subchannel computer analysis, an optimum value for the coefficient of Rowe and Angle's single-phase mixing correlation β. When the same analytical procedures were applied to data taken under conditions of subcooled nucleate boiling, an approximately linear correlation of β with average exit quality was found. The values obtained were for conditions of natural, or unaided mixing, and for design purposes should be considered as a dependable lower limit. Commercial rod-spacer designs intended to increase mixing will, of course, show substantially higher values of β. 18 references. (auth)

31169 NUCLEAR POWER PLANTS OF THE NEAR FUTURE IN THE U.S.: FLOATING PLANTS. Com. Naz. Energ. Nucl., Notiz.; 20: No. 1, 31-35(Jan 1974). (In Italian).

The increasing difficulties experienced in finding suitable nuclear power plant sites and the possibility of saving time and money through the standardization of plant components are making attractive the prospects offered by floating (offshore) power plants. Offshore Power Systems, a company set up by Westinghouse and Tenneco in 1972, is planning to equip such plants with a 3425 MW(t) four-loop reactor, with ice-condensation containment. The power generating section is equipped with a standard Westinghouse turbogenerator of 1150-MW net capacity. The Westinghouse plant now on order is described. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstract 31153.

31170 (AERE-R-7611) SOME FURTHER DEVELOPMENTS IN THE PREVIOUSLY DERIVED ANALYTICAL MODEL FOR CALCULATING STRESSES AND STRAIN RATES IN THE COATINGS OF HTR FUEL PARTICLES. Martin, D. G. (UKAEA Research Group, Harwell, Atomic Energy Research Establishment). Feb 1974. 26p. Dep. NTIS (U.S. Sales Only) $4.50. UK 50 pence.

It has been shown previously (J. Nucl. Mat. 48: 35 (1973) and Paper C1/5 at 2nd Int. Conf. on Structural Mechanics in Reactor Technology, Berlin (1973)) that stresses and strain rates in the coatings of HTR triso fuel particles may be readily calculated to an accuracy of 1 to 2% from certain derived analytical relationships. Such calculations are valuable for the assessment of the integrity of particles during irradiation. Despite the simplicity of this model it is capable of handling quite sophisticated input data; in particular it can deal with the variation of dimensional change rates in the pyrocarbon layers with both neutron dose and radial position within a particular layer. Two areas of subsequent development are described here: 1. The modification to the analytical relationships when not only dimensional change rates but also the elastic and creep constants are functions of neutron dose is discussed. 2. Analytical relationships for the stresses and strain rates at any point within a pyrocarbon layer are developed; these enable the corresponding maximum values in each layer to be calculated when dimensional change rates are a function of radial position. This extends the formulae given in the previous publications, which relate to the surfaces of layers and are not always adequate for calculating maximum stress and strain rate values when the dimensional change rates are dependent on the radial position within the layer. The physical significance of these refinements is discussed in detail. (auth)

31171 (CEA-CONF-2544) TRAPPING AND DESORPTION OF IODINE IN GRAPHITE-GAS REACTORS. Barbier, J.; Benezech, G.; Cadet, B.; Miribel, J.; Sigli, P. (Electricite de France, 75 – Paris). 1973. 16p. (In French). (CONF-730907-17). Dep. NTIS (U. S. Sales Only) $3.00.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In the six gas-cooled reactors operated by Electricité de France, the usual analyses have assumed the existence of iodine absorption by internal structures. A test was made in the Chinon-1 reactor in order to corroborate this hypothesis. It consisted in the study of the activity evolution and the physico-chemical form of iodine having introduced molecular ^{131}I in the coolant. The results show a very quick transformation of molecular iodine in penetrating form. The trapping speed by internal structures is high and the desorption phenomenon is slow. (auth)

31172 (CONF-730465-, pp vp. V. 2, Paper 212) DESIGN AND ACOUSTIC TESTS OF A DYNAMICALLY SCALED NUCLEAR REACTOR GAS CIRCUIT STRUCTURE. Fahy, F. J.; Rivenaes, U. (Central Electricity Generating Board, London). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

A ¼ scale model of the gas circuit structure of Dungeness B reactor has been built and tested for acoustically induced response studies. After a brief introduction to the theoretical basis of the model design the construction and instrumentation of the model is described. The method of testing and some experimental and theoretical results are presented. Finally the lessons learned from the model are discussed and an assessment is made of the value of dynamic model testing in the design process with some thoughts on the sodium cooled system. (auth)

31173 (CONF-730465-, pp vp. V. 2, Paper 214) DESIGN OF SOUND ABSORBING MATERIAL FOR USE UNDER HIGH GAS PRESSURE, HIGH NOISE LEVEL CONDITIONS. Bickers, B. H. (British Nuclear Design and Construction Ltd., Whetstone, Eng.); Owen, M. W. [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Sound absorbing materials used in nuclear reactor coolant circuits operate under high noise level and high gas pressure. As the acoustic flow patterns may be different from those occurring under atmospheric conditions, predictions of operational performance cannot be made directly from conventional standing wave tube tests. A high pressure standing wave rig was constructed and used for a series of experiments on a perforated plate absorber with steel mesh backing. The tests showed that the theoretical extrapolations from atmospheric tests previously used were inadequate for predicting operational performance. It was shown, however, that the variation of resonant frequency with changing geometry and gas conditions follows simple resonator theory. The relationship between the normal incidence properties measured in the experimental work and the actual performance when installed in the complex acoustic field existing in the reactor situation was investigated using a scale model and successful correlations were made using reverberant room theory. (auth)

31174 (CONF-730465-, pp vp. V. 2, Paper 216) ACOUSTICALLY INDUCED VIBRATION IN THERMAL INSULATION CONTAINMENT STRUCTURES FOR ADVANCED GAS COOLED REACTORS. Jones, E. A. C. (Nuclear Power Group Ltd., Knutsford, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

An account is given of some work carried out to develop thermal insulation designs to withstand predicted acoustic environments in the advanced gas-cooled reactors for the Hinkley Point B and Hunterston B power stations. After a short introduction to

the AGR system and to the basic thermal insulation design the philosophy of AGR acoustic testing is discussed and acoustic test facilities at TNPG are described. Main features of the insulation acoustic development program are outlined with particular reference to a novel problem associated with the type of structure used. The acoustic response of the most vulnerable part of the insulation containment structure was determined theoretically and this correlated quite well with the results of acoustic tests, both at atmospheric pressure and in high pressure gas, on insulation designs for several different parts of the reactor. The theory indicated an essential requirement of the design of the thermal insulation for the highest noise area of the reactor. (auth)

31175 (CONF-730465-, pp vp. V. 2, Paper 217) DISCUSSION OF THE MECHANISMS LIKELY TO CAUSE FAILURE OF PRESSURE VESSEL THERMAL INSULATION. Drake, M. E. (Central Electricity Generating Board, Berkeley, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

The basic mechanisms of flow and acoustic dynamic pressure fluctuations that can cause failure of the primary and secondary retaining systems of pressure vessel thermal insulation are discussed. Simple theories are presented to explain the basic dependancies of these mechanisms on the reactor operating parameters of flow velocity, density, and velocity of sound. Experimental data obtained during reactor commissioning are compared with these theories. Experimental procedures and instrumentation suitable for ascertaining the integrity of thermal insulation to its reactor environment are also discussed. Where possible the most suitable techniques are advocated. The practical solution to a reactor problem and the theoretical reasoning responsible for the solution are explained. Wear measurements from insulation removed from an operational reactor are presented, and compared with data obtained from laboratory test. (auth)

31176 (CONF-730465-, pp vp. V. 2, Paper 219) STUDY OF FLOW AND ACOUSTIC PHENOMENA IN A TUBE-BANK. Baylac, G. (Electricite de France, Chatou); Bai, D.; Gregoire, J. P. [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Flow-induced vibrations in heat-exchangers are becoming an important problem as the size of power plants increases. The noise from tube banks can be amplified by the acoustical resonances of the circuit, and can induce severe stresses in the structures. Work is described on the sources of pressure fluctuations due to turbulent flow in tube banks and on the acoustic response of complex circuits to these sources. (UK)

31177 (CONF-730465-, pp vp. V. 4, Paper 428) VIBRATION OF TUBE BANKS BY WAKE FORCE. Funakawa, M. (Kawasaki Heavy Industries Ltd., Kobe, Japan). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

It is believed that the cause of the failure of tubes of the steam raising unit at Tokai-Mura was vibration induced by wake force. Some results of studies on the vibration of tubes and tube banks together with acoustical vibration in relation to gas cooled atomic reactors are reported. (UK)

31178 (CONF-730465-, pp vp. V. 5, Paper 415) EFFECT OF SURFACE ROUGHNESS ON THE FLOW INDUCED RESPONSE OF A.G.R. FUEL RODS IN CHANNEL FLOW. Durrans, R. F.; Whitton, P. N. (Central Electricity Generating Board, Berkeley, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

The response to flow noise of multi-start helically ribbed pins is compared with that of the conventional design. An analytical solution suitable for estimating the response of a transversely ribbed rod in parallel gas flow is obtained. The effect of helical ribbing is to promote considerable swirl velocities. The theory is extended to account for this and it is shown that in general a slightly greater response is obtained. Laboratory experiments on single pins in pressurized CO_2 and in helium, using both helical and transversely ribbed pins, are described. The results of a further experiment on an instrumented cluster in a vertical CO_2 loop are also presented. In both cases agreement with the theoretical predictions is obtained. The variations in response with gas density and velocity and between helical and transverse ribbing are as predicted. Estimation of the absolute value of pin strain is good in the cluster experiment but less good in the single pin tests, due to the need to extrapolate available data. (auth)

31179 (CONF-730465-, pp vp. V. 5, Paper 512) MODELLING TECHNIQUES APPLIED TO CAGR ON-POWER LOADING. Bennett, M. J. (Brunel Univ., London). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

The application of modelling techniques to the problem of fuel assembly vibration during on-power loading of advanced gas cooled reactors is described. Dimensional Analysis was used to determine criteria upon which a modelling approach could be based. The relative significance of the resulting parameters was then investigated with a series of model fuel assemblies. The models are described and the overall information obtained is summarized to give an assessment of the relative importance of each of the modelling groups determined by Dimensional Analysis. In conclusion there is a review of the degree of correlation achieved between models and charge-discharge tests of prototype stringers in the CAGR Handling Rig at Windscale. (UK)

31180 (CONF-730465-, pp vp. V. 5, Paper 513) STABILITY OF REACTOR FUEL ELEMENTS DURING ON-POWER LOADING. Robson, J. A. (United Kingdom Atomic Energy Authority Reactor Group, Sellafield, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

The ability to load and unload the Advanced Gas Cooled Reactor fuel satisfactorily with the reactor at power is of considerable economic importance. To demonstrate and prove the process as fully as possible, a large experimental programme has been mounted, centered on the measurement of flow-induced instability and vibration in a full scale test facility in which the full dynamic conditions to which the fuel is exposed can be represented. This is discussed together with the supporting model and metallurgical work, and the validity of the test philosophy which has been developed is shown. The usefulness and range of applicability of the testing and analysis techniques are discussed. (auth)

31181 (CONF-730465-, pp vp. V. 5, Paper 514) OUT OF PILE DEVELOPMENT FOR THE ON-POWER REFUELLING OF HINKLEY POINT B REACTOR FUEL ASSEMBLIES. Edwards, H. K.; Bryant, T. G. (Nuclear Power Group Ltd., Risley, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

During refuelling on power, a fuel assembly passes through high velocity, high density, gas flows which cause it to vibrate in various modes, some of which produce impacting between the fuel assembly and the channel. A channel and fuel assembly were developed in which vibrations were reduced to an acceptable level and it was shown that the fuel reached its working position in a satisfactory state and without damage to reactor permanent components. For Hinkley Point B, basic design requirements were established in half scale and full scale light weight models in air flow. Instrumented full size fuel assemblies were also used in a rig capable of simulating reactor conditions. Instrument readings were compared with damage criteria derived from bench tests. When acceptable margins were obtained a new and inspected fuel assembly was subjected to multiple charges and discharges. The fuel assemblies were found to be in a good condition and any distortions of fuel braces and grids were within acceptable limits. It is concluded that within the limitations of out-of-pile simulation a satisfactory refuelling procedure was demonstrated. (UK)

31182 (CONF-730465-, pp vp. V. 5, Paper 515) DEVELOPMENT OF A STABLE FUEL ASSEMBLY FOR THE HINKLEY POINT B NUCLEAR REACTOR. Sansom, K. A. (United Kingdom Atomic Energy Authority Reactor Group, Springfields, Eng.); Edwards, H. K. [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Development work carried out to produce a stable fuel assembly for the Hinkley Point B reactor is described. Tests on a full-scale model demonstrated unacceptable vibration of the assembly and reactor guide tube in their original form. The design was evolved by progressive improvements in the detailed modelling of the assembly and channel, and by design modifications to restrain first the guide tube and then the fuel assembly. Criteria for allowable vibratory motion of the fuel were derived to provide acceptance limits for the residual vibration. (auth)

31183 (CONF-730465-, pp vp. V. 5, Paper 516) OUT OF REACTOR ENDORSEMENT OF THE ON LOAD REFUELLING PROCESS FOR MK 2 GAS COOLED REACTORS. Jones, C. H. (United Kingdom Atomic Energy Authority Reactor Group, Springfields, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Unsteady coolant gas flow causes characteristic but random oscillatory motion of fuel stringers when traversing the part of the refuelling route between the reactor and its refuelling machine. This is sometimes limited by impacts between the fuel stringer and the reactor channel. Although tests on single fuel elements

have indicated the impulse limits which can be tolerated, this data does not cover the element to element interaction or the range of actual impacts. To demonstrate convincingly that the complete stringer can withstand the refuelling experience, and shuffling, without operational impairment repetitive refuelling insertions, referred to as "multi-dunk" tests, are suggested. The procedure for the design of multi dunk tests is developed showing how factors can be derived for multiplying the number of reactor insertions to cover the effects of scatter between the shock spectra of individual insertions, of temperature, and of irradiation. A factor of 2 is suggested to demonstrate the reserve of fatigue strength remaining. Some of the fuel pins will be stiffened substantially under irradiation. This increases the loading on their support braces for a specific impulse. The effect can only be simulated by using appropriately stiff pins. (UK)

31184 (CONF-730465-, pp vp. V. 5, Paper 518) ANALYSIS OF VIBRATIONS OF A. G. R. FUEL STRINGERS. Reynolds, A. J.; Large, J. H. (Brunel Univ., London). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Flow-induced vibrations observed during development tests representing both on-load refuelling and normal service conditions have been studied. The work has proceeded in parallel with development and proving tests on A. G. R. stringers, and is intended as an aid, in interpreting the behavior of existing stringers and in developing future reactor designs. In the analytical model, account is taken of the large axial gas forces, both those applied by the major cooling flow through the stringer and charge tube, and those applied by the moderator-cooling flows in the annulus between stringer and fuel channel or charge tube. A variety of constraints can be applied to the stringer, representing the support stool at the bottom (when the stringer is in pile) and, more generally, certain seals at the bottom of the fuel train and above it. The analysis predicts the natural frequencies and normal modes of the stringer motion and also interelement forces within the stringer. Representative results are presented for a stringer and charge path combination representative of current designs. (auth)

31185 (CONF-730465-, pp vp. V. 6, Paper 625) DEVELOPMENT OF VIBRATION MEASUREMENTS IN SEVERE ENVIRONMENTS. Walton, H. (United Kingdom Atomic Energy Authority Reactor Group, Seilafield, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

The history of vibration and displacement measurement in the Windscale CAGR test rig is outlined with particular emphasis on the shortcomings of existing transducer systems. The importance of high temperature operation, wide bandwidth response and satisfactory operation in high acoustic noise levels is stressed. A solution to the measurement of vibration and displacement is offered which has the advantage of being a non-contacting system and also has the ability to work over very long cables. The new principle is described in detail together with an outline of different types of measuring systems that have been developed on this basis. (auth)

31186 (CONF-730465-, pp vp. V. 6, Paper 626) DEVELOPMENT OF SPECIAL TRANSDUCERS FOR VIBRATION MEASUREMENTS IN HOSTILE ENVIRONMENT. McCalvey, L. F.; Thompson, A. (International Research and Development Co. Ltd., Newcastle upon Tyne, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

A description is given of four transducers, two capacitive and two inductive, specially developed to obtain vibration test information in specific environments in which commercially available equipment could not be used. Of the inductive transducers one was an inertial device to measure low frequency sinusoidal movements in elevated temperature hostile environments in which no fixed reference was available, such as would be of interest in relation to the movement of AGR fuel stringers during charge and discharge. The other was a compensated strain transducer for operation up to 1000°C. (UK)

31187 (DOCKET-50267-123) FORT ST. VRAIN NUCLEAR GENERATING STATION. Environmental Radiation Surveillance Program for the Period July–December 1973. (Public Service Co. of Colorado, Denver (USA)). 21 Mar 1974. 75p. Dep. NTIS $6.75.

The average gamma-ray exposure rates from 37 locations show no significant difference in value between the facility or the reference area. Data are given for gross alpha and beta activity in air particulates, specific activity in tritiated water vapor. Stream temperatures and gross beta activity in water and bottom sediments are recorded. Tabulations of the iodine-131, cesium-137 and potassium-40 contents in milk, the tritium and strontium concentrations in forage, and the cesium-137 in beef cattle are presented. Gross beta and strontium activities in algae and aquatic ecosystems are described. (FS)

31188 (EIR-250) BINARY CYCLES FOR A HIGH TEMPERATURE GAS-COOLED REACTOR WITH HELIUM TURBINE. Markoczy, G. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jan 1974. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

The heat rejection of power plants to the environment can be reduced by using a binary (bottoming) power cycle which receives its energy input from the primary cycle cooler. High temperature gas cooled reactors with helium turbine are particularly favorable for binary cycle application due to their relatively high heat rejection temperatures and wide temperature range. The feasibility of such cycles was investigated for several working fluids. Their thermodynamic characteristics and estimated efficiency were compared. (11 references) (auth)

31189 (GA-A-12628(Rev.)) DESIGN AND PERFORMANCE OF COATED PARTICLE FUELS FOR THE THORIUM CYCLE HTGR. Gulden, T. D.; Harmon, D. P.; Stansfield, O. M. (General Atomic Co., San Diego, Calif. (USA)). 24 Jan 1974. Contract AT(04-3)-167. 28p. (CONF-730912-4). Dep. NTIS $3.50.

From international conference on physical metallurgy of reactor fuel elements; Berkeley, England, UK (2 Sep 1973).

The reference fuel for the Thorium Cycle HTGR, being developed commercially in the United States, utilizes separate fissile and fertile coated particles, which are blended together and bonded into fuel rods by means of a carbonaceous matrix. Fissile particles have TRISO coatings while the fertile particles have BISO coatings. Both types of coated particles are designed based on the results of extensive irradiation tests and sophisticated analytical models. The mechanical design of both BISO and TRISO coated particles is aided by analytical stress models using geometrical factors and basic properties and irradiation behavior of the coating materials as inputs. To minimize the importance of uncertainties in the input data, stress model calculations are always normalized to the results of irradiation tests on fuel particles. The chemical performance of coated particle fuels is dominated by unidirectional migration of the fuel kernel into the coatings along the temperature gradient. This phenomenon is generally referred to as the amoeba effect. The amoeba effect in carbide fuels is shown to be controlled by carbon thermal diffusion in the fuel phase, while in oxide fuels it is apparently controlled by gas phase carbon transport in the accessible void volume within the coated particle. It is demonstrated that with proper knowledge and control of the mechanical and chemical aspects of performance, a variety of coated particle fuel types may be designed to perform adequately under HTGR conditions. 12 references. (auth)

31190 (GA-A-12821) PCRV DESIGN AND VERIFICATION. Cheung, K. C. (General Atomic Co., San Diego, Calif. (USA)). 1 Mar 1974. 94p.

The applicability and validity of the analytical methods, structural model testing, and finite element computer codes used in the design of multi-cavity prestressed concrete reactor vessels are established. (29 references) (auth)

31191 (GULF-EL-A-12426) COMPUTER-CONTROLLED REFUELING MACHINE AT FORT ST. VRAIN. Smith, C. W.; Mathie, F. (Gulf Electronic Systems, San Diego, Calif. (USA)). 6 Dec 1972. Contract AT(04-3)-633. 15p. (CONF-721202-20). Dep. NTIS $3.00.

From nuclear science symposium; Miami Beach, Florida, USA (6 Dec 1972).

A computer-controlled fuel handling machine used to refuel a nuclear power generating station is described. The refueling process and the basic concepts of the electronic system controlling the process are explained. A comparison is made between manual control and automatic control, using data from actual operation. (auth)

31192 (GULF-GA-A-12244) PREOPERATIONAL AND STARTUP TESTING EXPERIENCE AT FORT ST. VRAIN NUCLEAR GENERATING STATION. Swart, F. E.; Kantor, M. E. (Gulf General Atomic Co., San Diego, Calif. (USA)). Sep 1972. Contract AT(04-3)-633. 32p. (CONF-7209110-1). Dep NTIS $3.75.

From joint power generating conference; Boston, Massachusetts, USA (11 Sep 1972).

The unique characteristics of the Fort St. Vrain Nuclear Generating Station are described. The special requirements for preoperational and startup testing of this second generation High-Temperature Gas-Cooled Reactor are reviewed. Actual experience during testing of several reactor plant systems is described. The startup testing program is also described. 5 references. (auth)

31193 (GULF-GA-A-12651) HTGR GAS TURBINE POWER PLANT CONFIGURATION STUDIES. Adams, R. G.; Bell, F. R.; McDonald, C. F.; Morse, D. C. (Gulf General Atomic Co., San Diego, Calif. (USA)). 26 Jul 1973. Contract AT(04-3)-167. 37p. (CONF-731105-10). Dep. NTIS $4.00.

From winter meeting of American Society of Mechanical Engineers; Detroit, Michigan, USA (11 Nov 1973).

The High Temperature Gas Cooled Reactor (HTGR) gas turbine power plant concept combines the existing design HTGR core with a closed-cycle helium gas turbine power conversion system which is driven by the reactor coolant helium. The use of a gaseous working fluid enables the heat rejection to be well matched to the capabilities of dry cooling towers which can minimize environmental impact while conserving water resources. The objective of the studies reported was to establish the main features of the reactor and gas turbine power conversion system layout for subsequent preliminary design studies. Initial decisions were made to adopt an integrated arrangement (gas turbine loops located within the prestressed concrete reactor vessel) embodying multiple turbomachinery loops, based on a non-intercooled cycle with a high degree of heat recuperation. The plant configuration studies consisted of the preparation and evaluation of alternative designs incorporating various orientations of the turbomachinery and heat exchangers with respect to the reactor core and primary and secondary containment systems. Design studies were made of single-shaft and split-shaft turbomachinery in conjunction with both horizontal and vertical generators and were evaluated on the basis of control, safety, and maintenance. 7 references. (auth)

31194 (JUL-1044-RG) MEASUREMENT OF THE GAS-OUTLET-TEMPERATURES AND THE FLOW BEHAVIOR OF SPHERES IN THE FLOWING CORE OF A PEBBLE-BED REACTOR WITH A NEW DEVELOPED MEASURING SYSTEM. Ramadan, M. N. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Feb 1974. 182p. (In German). Dep. NTIS (U.S. Sales Only) $12.25.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

Flattened graphite spheres (moderator spheres) were used for direct measuring of the maximum gas outlet cooling temperature in the core of the AVR Juelich pebble-bed reactor. These spheres, also called gas temperature measuring elements, contained 34 or 68 thin wires of different metals and metal-alloys which melt upon reaching their melting point. The wires were in Al_2O_3 or graphite melting pots or they were melted in quartz ampules. Melting pots and ampules were admitted in a holder. The gas temperature measuring element was supplied with cooling channels for a better cooling gas flow through the sphere. For the determination of the hold-up time of the balls in the core and for the estimation of their way through the core the spheres were held in a special collecting tank with a spiral chute and a counter. At the same time the behavior of quartz under high radiation dose and under high temperatures was investigated. To save time and money a new radiographic method of post-investigation was developed. With the aid of their residual activity the melted or non-melted indicators were made visible on a special film. A comparison was made of theoretical calculations and the measured temperatures. (auth)

31195 (LA-UR-74-213) HIGH-TEMPERATURE NUCLEAR REACTORS AS AN ENERGY SOURCE FOR HYDROGEN PRODUCTION. Balcomb, J. D.; Booth, L. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 7p. (CONF-740306-6). Dep. NTIS $3.00.

From hydrogen economy M'ami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

Application of current high-temperature reactor technology to hydrogen production is reviewed. The requirements and problems of matching a thermochemical hydrogen production cycle to a nuclear heat source are discussed. Possibilities for extending the temperature of reactors upward are outlined. The major engineering problem is identified as the development of a high-temperature process heat exchanger separating the nuclear heat source from the chemical process. (auth)

31196 (RD/B/N-2882) MODEL FOR PREDICTING THE BULK ARRIVAL RATE OF PARTICULATE ON A.G.R. FUEL PIN SURFACES. Reeks, M. W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Dec 1973. 26p. Dep. NTIS (U. S. Sales Only) $4.50.

On the basis that diffusion in the bulk flow may be regarded as the controlling process in the deposition of particulate on AGR fuel pins, a stochastic model for particle transport has been used to predict bulk deposition on a single perfectly sticky AGR fuel pin which forms the central core of an annular flow system. The flow region close to the ribs is regarded as an extended boundary layer and is assumed to be perfectly absorbing in the presence of a perfectly sticky surface. In addition the motion of particulate in this region is assumed not to seriously influence the overall arrival rate at the pin surface, merely the deposition profile. The results predicted by this model are then compared with some experimental results obtained from an air rig. (UK)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 31277.

31197 (AECL-4709) WHY CANDU? Its Achievements and Prospects. Gray, J. L. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1974. 18p. Dep. NTIS (U. S. Sales Only) $4.00. AECL $0.50.

The CANDU/PHW reactor is commercially viable under many conditions and it is technically acceptable. The simple construction using pressure tubes and the simple, low cost fuel cycle are attractive to many countries. The performance of the 2000 MW(e) Pickering Station has demonstrated many of the claims for this system and the large Canadian program ensures adequate support for continued success. Future development offers improvement to the PHW version and other coolants offer prospects of lower capital costs and higher efficiencies. (auth)

31198 (CONF-730465-, pp vp. V. 4, Paper 424, Pt. 2) EXPERIMENTAL STUDIES ON FLOW INDUCED VIBRATION TO SUPPORT STEAM GENERATOR DESIGN. Part II. Tube Vibration Induced by Liquid Cross-Flow in the Entrance Region of a Steam Generator. Pettigrew, M. J.; Platten, J. L.; Sylvestre, Y. (Atomic Energy of Canada Ltd., Chalk River, Ont.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

At the entrance to the tube bundle of recirculating type steam generators, tube vibrations may be induced by cross-flow. The results of an experimental vibration study on a full size model of a 30° sector of the lower region of a steam generator under realistic flow conditions are reported. The vibration response of the tubes and in particular the nature of the flow-induced excitation forces are investigated. Tube vibration amplitudes under normal operating steam generator flow conditions for the Bruce reactor were generally less than 0.001 in rms, so no vibration problems are anticipated there. The flow-induced excitation forces appear to be broad-band random in nature. The vibration response is directly related to a power of the flow velocity. (auth)

31199 (CONF-730465-, pp vp. V. 4, Paper 523) VIBRATION ANALYSIS IN THE DESIGN OF STEAM GENERATING EQUIPMENT FOR THE BRUCE NUCLEAR POWER STATION. Schneider, W. (Babcock and Wilcox Canada Ltd., Toronto); Pettigrew, M. J.; Hodge, R. I. [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

The final flow-induced vibration analysis involved assessing the design for vulnerability to parallel and cross flow of liquid and two-phase mixtures. Tube response to turbulent and periodic hydraulic forces, and the possibility of elasto-hydrodynamic instability were investigated. The analysis indicated that there would be no significant amplitudes of tube motion. A new method for calculating the natural frequencies of U-bend tubes, new data on periodicity of hydraulic forces in cross-flow and an estimate of tube amplitude in damped resonant motion were included in the analysis. (auth)

31200 (CONF-730465-, pp vp. V. 5, Paper 525) VIBRATIONS INDUCED BY A TWO-PHASE-PARALLEL FLOW TO A ROD BUNDLE. Preliminary Experiments on the Surface Tension and Gas Density Effect. Dallavalle, F.; Rossini, T.; Vanoli, G. (CISE, Milan). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Gas density and surface tension are the most significant physical properties affecting the thermohydraulic behavior of a two-phase (gas + liquid) flow. It is necessary to know the effect of these parameters on rod bundle vibration, such as a fuel element for a pressure tube reactor, induced by a two-phase parallel flow, most experiments in support of fuel element development are carried out in "simulated" flow conditions, e.g., air-water at atmospheric pressure instead of steam-water flow at high pressure. Experiments were carried out with water-nitrogen and acetone-nitrogen mixtures at different pressures up to 20 bars flowing adiabatically along a 4 m long 19-rod cluster in a pressure tube. The geometry is similar to that of a CIRENE reactor fuel assembly. Measurements on pressure tube vibration and on

bundle-to-pressure tube relative motion were performed. Contact forces between bundle spacers and tube wall and pressure fluctuations were also measured. Although no general conclusion could be drawn from these experiments, both physical properties showed a significant influence; vibrations were lower when surface tension was low and gas density was higher. The same results are discussed on the basis of the information available in literature. (auth)

31201 (INIS-mf-929) COMPUTER BASED DATALOGGER SYSTEM FOR A NUCLEAR REACTOR. Bhargava, R.; Verma, S. N.; Kundagolkar, S. R.; Mittal, A. S.; Biswas, B. B. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A flexible computer-based data logger system is described. The datalogger specifications are based on the requirements of a 200 MW(e) CANDU type reactor. The hardware and software are modular in nature and the system can be easily modified for a smaller or a bigger plant. The system monitors up to 512 analog and 60 contact inputs. Logging can be done for 100 points at selectable intervals. A maximum of 100 points can be trend-recorded with sampling frequency varying from 30 seconds to 1 hour. Interaction with operator is achieved through an operator's console. Major system modifications can be made using a teletypewriter. A comparison with a hard-wired data logger is also made. (INIS)

31202 (INIS-mf-1089) CURRENT THOUGHTS ON PRIMARY HEAT TRANSPORT SYSTEM FOR NARORA ATOMIC POWER STATION. Chatterjee, S. K.; Sharma, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The primary heat transport system for Narora Power Station is discussed. Pumps, and boilers, size has been doubled compared to earlier 200 MW(e) units with a view to standardize a unit size which can be used for 500 MW(e) reactors. (auth)

Power Reactors, Breeding

Refer also to abstracts 29139–29145, 29147–29150, 29152, 29153, 30090, 30150, 30776, 31153, 31483, and 31619.

31203 (ANL-8079) CONTINUOUS MONITORS FOR TRITIUM IN SODIUM COOLANT AND COVER GAS OF AN LMFBR. Kumar, R.; Panek, A. F.; Raue, D. J.; Nelson, P. A. (Argonne National Lab., Ill. (USA)). Mar 1974. Contract W-31-109-eng-38. 20p. AT.

Continuous monitors for tritium in the sodium coolant and the cover gas of a fast breeder reactor have been developed. The sensor for the monitors consists of a thin nickel membrane which permits the diffusion of tritium into an argon sweep gas containing 1 to 5% hydrogen. The tritium content of the sweep gas leaving the sensor is determined by disintegration-rate counting in an ionization chamber. The monitors for sodium are sensitive to 0.04 nCi of tritium/g of sodium (1 curie = 2.06×10^{19} atoms of tritium); for the cover gas monitors, the sensitivity level is 0.6×10^{11} atoms of tritium/liter of gas. For comparison, the typical tritium content of the primary sodium in EBR-II is 50 nCi/g, and in the primary cover gas it is 3×10^{12} atoms/liter. 12 references. (auth)

31204 (ANL-CT-74-9) EXPERIMENTAL MIXING STUDIES AND VELOCITY MEASUREMENTS WITH A SIMULATED 91-ELEMENT LMFBR FUEL ASSEMBLY. Lorenz, J. J.; Ginsberg, T.; Morris, R. A. (Argonne National Lab., Ill. (USA)). Mar 1974. 75p. AT.

Experimental mixing studies were conducted using water with a 91-element bundle in order to establish a data base for calibrating thermal hydraulic codes and to supplement and clarify existing mixing data. An electrolytic tracer was employed in conjunction with an isokinetic sampling technique which permitted mixed mean subchannel concentrations and flowrates to be measured without incurring errors resulting from local subchannel gradients. Isokinetic velocity measurements revealed that the average corner, edge, and central channel velocities are nearly equal to the bundle average velocity. While in agreement with other recent experimental data, these measurements are somewhat different than predictions based on hydraulic diameter considerations. Edge channel concentration data indicated that the effective swirl velocity for the CT 91-pin bundle was approximately 1.2 times that predicted assuming the fluid follows the wire wrap angle. By comparing the present data with the HEDL 217-pin data it was shown that the swirl for a 217-pin is less than that for a 91-pin bundle. Both velocity and concentration results from the present study were in good agreement with results from the recently completed RAS 91-pin experiment. Neither the CT nor RAS 91-pin bundle results were sensitive to Reynolds number in the range Re = 9000 to 24,000. 26 references. (auth)

31205 (ANL-RDP-25) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, FEBRUARY 1974. (Argonne National Lab., Ill. (USA)). 29 Mar 1974. Contract W-31-109-eng-38. 147p. AT.

Progress in LMFBR development studies is reported under the following headings: EBR-2; LMFBR design support; instrumentation and control; fuels and materials development; reactor physics; reactor safety; and environmental studies. (DCC)

31206 (BNWL-1804) EXPERIMENTAL STUDY OF AXIAL AND CROSSFLOW VELOCITY IN A 7-PIN WIRE WRAPPED BUNDLE. Wheeler, C. L.; Rowe, D. A.; Smith, J. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 4 Feb 1974. Contract AT(45-1)-1830. 74p. Dep. NTIS $5.45.

The results of an experimental study of axial and crossflow velocity in a 7-pin wire wrapped bundle similar for FFTF fuel bundles are reported. The results are compared with the forced crossflow model of the COBRA-III C computer program. (JWR)

31207 (BNWL-B-339) ELECTROMAGNETIC SELF-EXCITATION EFFECTS IN LIQUID METAL COOLED REACTORS. Lessor, D. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1973. 23p. Dep. NTIS $4.25.

For Westinghouse Hanford Co., Richland, Wash.

Electromagnetic self-excitation effect is a possible problem in LMFBR's. Geometry and flow parameters may rule it out; the magnetic Reynolds number criterion does not. The components in which the electromagnetic self-excitation effect may occur in liquid metal loops are analyzed. The conditions required for the occurrence of the effect and its consequences are described. (auth)

31208 (CEA-CONF-2546) COATED PARTICLE FUEL ELEMENT GBR 3: DESIGN AND FABRICATION PROBLEMS. Bujas, R.; Ringot, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). 1973. 35p. (In French). (CONF-731065-1). Dep. NTIS (U.S. Sales Only) $3.75.

From meeting on gas-cooled fast reactors; Wuerenlingen, Switzerland (23 Oct 1973).

The fabrication of the coated particle fuel element GBR 3 presents special problems. The fuel element is a modular element in which the elementary cell consists of 2 internal and external vertical tubes fixed on horizontal plates so as to form a case to be filled with particles. The fabrication technology is outlined. One of the problems of the behavior of the plates is the stresses created by eventual hot points and the necessity of maintaining a certain local flexibility with the simultaneous maintenance of a rigidity sufficient to support the aerodynamic effects. The solution was realized by the use of wires with nodes. (10 figures) (JSR)

31209 (CONF-730465-, pp vp. V. 2, Paper 213) DYNAMIC BEHAVIOUR OF MK 2 CAGR FUEL PINS IN A FLOW AND NOISE ENVIRONMENT. Bramwell, D. (United Kingdom Atomic Energy Authority Reactor Group, Springfields, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

The Mark 2 CAGR development program included work on the derivation of fatigue and wear acceptance criteria for fuel element component damage arising from vibration. Component vibration was measured under simulated new core reactor channel conditions in the SCOT loop at RFL Springfields for comparison with these criteria. Fuel pin vibration responses are discussed. The three processes contributing are complete fuel assembly movement, flow excitation, and noise excitation. The experiments showed that the dominant strain response of fuel pins to stringer oscillation, to parallel flow, and to a noise environment in the CAGR fuel stringer design, arises from energy transmission through the support grids. Average and maximum total strain response were obtained and used with metal fatigue and wear criteria to define the fraction of pins at risk in the reactor. The indication is that no pin, in one reactor charge, is at risk due to induced vibration. The experiment shows the importance of examining all possible sources of excitation in order to define the fatigue or wear limitations on the life of a component and shows that theoretical prediction of responses to pressure fluctuations in the boundary layer or to acoustic coupling would be misleading. (auth)

31210 (CONF-730465-, pp vp. V. 2, Paper 215) RESPONSE OF FUEL PINS TO ACOUSTIC EXCITATION IN THE PRESENCE OF FLOW WITHIN AN ADVANCED GAS COOLED REACTOR. France, E. R. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Tests were carried out in an ambient temperature pressurized rig, simulating a fuelled advanced gas-cooled reactor channel, to measure the effects of flow and gas circulator noise on the strains measured on fuel pins within the fuel elements. The results showed that rms strains not exceeding $\sim 3 \times 10^{-6}$ may be present owing to flow alone. Cross spectral analysis between strain-gauge signals and signals from pressure transducers in the rig inlet plenum chamber demonstrated that rms noise induced strains, as modified by flow, will not exceed 10×10^{-6}. The latter figure is based on an inlet sound pressure of 160 db and it has been pessimistically assumed that the total sound energy may be concentrated at a frequency of pin resonance. (auth)

31211 (CONF-730465-, pp vp. V. 2, Paper 628) REVIEW OF VIBRATION PROBLEMS ASSOCIATED WITH FLOW THROUGH ANNULAR PASSAGES. Parkin, M. W. (United Kingdom Atomic Energy Authority Reactor Group, Sellafield, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Experience with the Windscale AGR identified the potential for component vibration in annular flow systems formed by two bounding surfaces which are not rigidly interconnected. The problems encountered in WAGR, and the solutions adopted are outlined. Investigations in support of the civil reactor program stimulated by these findings are indicated. These are: full scale testing of annular flow situations; model studies; basic studies. Basic studies are renewed and it is concluded that, in view of the complex interrelation of several mechanisms and the design restraints imposed by the nuclear application, full scale testing is essential in most cases. (auth)

31212 (CONF-730465-, pp vp. V. 5, Paper 414) INVESTIGATIONS OF COOLANT FLUCTUATIONS WITHIN FAST BREEDER FUEL ELEMENT BUNDLE FLOW. Hess, B.; Benemann, A.; Brockmann, K.; Relic, M. (Interatom, Bensberg, Ger.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Some of the results obtained during a long term test of a complete SNR fuel element in the AKB sodium loop of near reactor dimensions are described. Special instrumentation was used to measure flow and pressure fluctuations of sodium bundle flow, flow-induced fuel pin vibrations and acoustic noises. The qualitative picture of fluctuations in sodium bundle flow is supported by results of experiments with water flow, concerning especially the pressure field and its decay characteristic in the region of a spacer grid. (auth)

31213 (CONF-730465-, pp vp. V. 5, Paper 524) THEORETICAL INVESTIGATION OF THE RESPONSE TO THE HYDRAULIC EXCITATIONS OF SOME PEC REACTOR INTERNALS. Cesari, E.; Curioni, S. (CNEN, Bologna). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

An analysis has been made of the dynamic behavior of some structures immersed in a sodium-cooled fast nuclear reactor (PEC). (auth)

31214 (CONF-730465-, pp vp. V. 5, Paper 526) STUDY OF VIBRATION RISKS IN THE STRUCTURES OF THE REACTOR PHENIX. Gama, J. M. (CEN de Saclay, Gif-sur-Yvette, France); Tigeot, Y.; Payan, F. [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

To determine the vibratory behavior of Phenix it was necessary to measure in air the natural frequencies of the structures with their associated deformations, together with the generalised mass and damping coefficients. Variable-frequency sinusoidal forces obtained by several electrodynamic stimulators were therefore applied to the structures. Vibration instruments designed to operate in sodium were also tested. From the data obtained the natural frequencies in sodium and the corresponding generalized masses can be calculated, after which the standard deviation of the vibration amplitudes can be estimated. Hydraulic and mechanical tests without power will show the actual vibratory behavior of the structures under the effect of the sodium flow. (auth)

31215 (CONF-730465-, pp vp. V. 6, Paper 614) SOME BACKGROUND STUDIES OF ACOUSTIC VIBRATION IN FAST REACTORS. Bentley, P. G. (United Kingdom Atomic Energy Authority Reactor Group, Risley, Eng.); Firth, D. [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Current British designs for sodium cooled fast reactors have the nuclear core, heat exchangers and pump immersed in a pool of liquid sodium which allows strong vibration interaction between the various components and the acoustic excitation provided by the pump. The excitation of various components is considered, particularly the pool containment tank and the immersed primary coolant ducts by the predominantly sinusoidal acoustic pressure excitation. Background theoretical and laboratory investigations show agreement for the resonant frequencies of simple liquid systems, both those which are predominantly acoustic and those which are predominantly structural. Amplitudes of vibration are more difficult to calculate and may be underestimated by a factor of up to 100 if simple classical liquid/structure relationships are used. It is recognized that interaction between liquid and structure is more complex and influenced strongly by system boundaries, initial mechanical distortions, and the possibility of dynamic instability, and some attempts to calculate this for the boundaries effect are given. Because statistical energy analysis is complex to apply in liquid/structure interaction, analytical procedures are adopted for the theoretical work. (auth)

31216 (CONF-730910-10) EXPERIMENTAL GRID-TYPE SUBASSEMBLIES FOR IRRADIATION IN EBR-II. Levine, P. J.; Schwallie, A. L. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). [nd]. Contract AT(11-1)-3045. 2p. Dep. NTIS $4.00.

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973).

Alternate design concepts for future FTR and LMFBR cores utilize stainless steel honeycomb grids to space the fuel pins radially and minimize bowing throughout core lifetimes. In order to evaluate the performance of grid-type subassemblies in a fast reactor environment, a series of irradiation experiments in the EBR-II have been planned and designed by the Westinghouse Advanced Reactors Division under contract to the United States Atomic Energy Commission. Three unencapsulated 37-pin subassemblies, designated WSA-3, WSA-4 and WSA-8, containing tri-dimple, honeycomb grids at various axial locations, have as their overall test objectives to investigate the combined effects of radiation, flowing sodium, stress and temperature on the mechanical and corrosion behavior of grids, on the performance of mixed-oxide fuel pins operating under various conditions, and on the fuel pin-grid interactions. (auth)

31217 (EIR-253) THORIUM–URANIUM FAST/THERMAL BREEDING SYSTEM WITH MOLTEN SALT FUEL. Taube, M. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Feb 1974. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

The fuel cycle scheme is presented for a breeding fast reactor and thermal reactor combination utilizing a molten salt fuel of thorium–uranium. Safety aspects of the fuel cycle are discussed. (13 references) (DCC)

31218 (EURFNR-1115) FAST BREEDER PROJECT. Second Quarterly Report, April 1–June 30, 1973. (Kernforschungszentrum Karlsruhe (F. R. Germany)). 1973. 303p. (KFK-1273/2). Dep. NTIS $17.25.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Work performed at the Gesellschaft fuer Kernforschung m.b.H., Karlsruhe, or on its behalf within the framework of the Fast Breeder Project (PSB) is reported. The subjects of the investigations are: fuel pin development, materials studies and materials development, work on the fuel cycle, physics, safety and technological questions. (GE)

31219 (GEAP-12466) THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES. Quarterly Report No. 25, August 1, 1973–November 1, 1973. Aitken, E. A.; Dutina, D.; Adamson, M. G.; Evans, S. K.; Ludlow, T. E. (General Electric Co., Pleasanton, Calif. (USA). Vallecitos Nuclear Center). Dec 1973. Contract AT(04-3)-893. 12p. Dep. NTIS $4.00.

Progress is reported on the continuing scope of work related to fission-product cladding interaction, sodium-fuel chemical interaction, and O:M and Pu:U redistribution. (auth)

31220 (GEAP-13965) DEVELOPMENT OF LARGE ELECTROMAGNETIC PUMPS FOR MAIN HEAT TRANSPORT SYSTEMS OF LMFBRs. Collins, G. D. (comp.). (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jun 1973. Contract AT(04-3)-893. 115p. AT.

This study was undertaken to assess the need for development of large electromagnetic pumps for the main heat transport system of LMFBR plants. The pump capacities considered are 14,500 gpm, 26,400 gpm, and 90,000 gpm, all at a head of approximately 500 feet of sodium. These ratings are representative of FFTF, the first Demonstration Plant, and a future 1200-MW(e) LMFBR. The zero leakage property as well as the convenient flexibility and relative simplicity of installation and operation of EM pumps

have long been recognized and utilized in sodium service systems of nearly all sodium-cooled reactors since 1950. For main heat transport system service the economic disadvantage of their lower efficiency, compared to mechanical pumps, is shown to be overcome by the economic value of their higher reliability. 10 references. (auth)

31221 (HEDL-SA-646) DYNAMICS OF MOLTEN FUEL MOTION DURING A FAST REACTOR OVERPOWER TRANSIENT. Willenberg, H. J.; Partain, W. L.; Waltar, A. E. (WADCO Corp., Richland, Wash. (USA)). 1973. 21p. (CONF-740401-2). Dep. NTIS $3.00.

From conference on fast reactor safety; Los Angeles, California, USA (2 Apr 1974).

Fuel expulsion during an unprotected overpower transient in a fast reactor has been widely suggested as a potential shutdown mechanism. However, all previous studies have been based on the assumption that the fuel escaping the pin originates uniformly from within the entire molten fuel region of the pin. Furthermore, most studies have assumed that the fuel/coolant interaction zone, which envelopes the cladding rupture point in the coolant channel, also contains a spatially uniform fuel density. The validity of these assumptions, in addition to questions such as the effects of rupture size, gas to liquid ratio in the fuel/gas mixture, and the effects of molten fuel plate-out following the expulsion process are analyzed. (6 references) (auth)

31222 (JPRS-60560) 3rd ALL-UNION CONFERENCE ON DISSOCIATING GASES AS COOLANTS AND WORKING SUBSTANCES OF ATOMIC POWER PLANTS, MINSK, USSR, JANUARY 1972. Translation of Dissotsiiruyushchiye Gazy kak Eteplonositeli i Rabochiye Tela Energeticheskikh Ustanovok, 1973, Minsk. (CONF-720130-). 220p. NTIS.

Separate abstracts were prepared for each of the 24 papers included. (JMR)

For abstracts of individual papers see: 30046–30048, 30151, 31223–31230, 31259, 31379–31384, 31395–31398, and 31412.

31223 (JPRS-60560, pp 4-10) DISSOCIATING GASES AS COOLANTS FOR FAST REACTORS. Krasin, A. K. 16 Nov 1973. Translated from pp 6-12 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

Factors necessitating the development of fast breeder reactors are discussed. Some of the attractive features of the dissociating gas N_2O_4 as the coolant and the turbine working substance for fast breeder reactors are described. Planning and research requirements for the development of a N_2O_4 cooled fast breeder are reviewed. (JWR)

31224 (JPRS-60560, pp 11-24) DEVELOPMENT AND OPTIMIZATION OF PARAMETERS OF ATOMIC POWER PLANTS WITH HIGH-POWER FAST REACTORS USING DISSOCIATING GASES AS COOLANTS. Nesterenko, N. V. 16 Nov 1973. Translated from pp 13-28 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The economic and fuel reserve factors stimulating the development of alternative coolants for fast breeder reactors are reviewed. The thermophysical characteristics of N_2O_4 suggesting its use as a fast reactor coolant are examined. The selection of equipment parameters and the thermal heat conversion scheme for an N_2O_4 cooled reactor are discussed. (JWR)

31225 (JPRS-60560, pp 43-49) SOME RESULTS OF TECHNOLOGICAL AND ECONOMIC OPTIMIZATION OF THE THERMODYNAMIC PARAMETERS OF ATOMIC POWER PLANTS WITH FAST REACTORS WITH DISSOCIATING N_2O_4 COOLANT. Krasin, A. K.; Nesterenko, V. B.; Bubnov, V. P.; Lomasheva, N. I.; Nesterenko, I. E. 16 Nov 1973. Translated from pp 50-56 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The optimal thermodynamic parameters of an N_2O_4 cooled fast reactor were evaluated from an economic viewpoint. The results show that higher temperature cycles are more efficient while lower temperature plants have better fuel characteristics. Further work is necessary to determine the optimum temperature for greatest efficiency and fuel performance. (JWR)

31226 (JPRS-60560, pp 50-60) COMPLEX TECHNOLOGICAL AND ECONOMIC INVESTIGATIONS OF CIRCUITS AND PARAMETERS OF ATOMIC POWER PLANTS WITH A DISSOCIATING WORKING SUBSTANCE. Popyrin, L. S.; Starostenko, N. N. 16 Nov 1973. Translated from pp 57-68 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants.

The formulation of a mathematical model of a sodium cooled fast reactor with a dissociating gas working substance is described. The use of the model for the technological and economic analysis of such a plant is illustrated. (JWR)

31227 (JPRS-60560, pp 61-65) COMPARATIVE ANALYSIS OF N_2O_4, He, AND CO_2 GAS AND GAS-LIQUID CYCLES. Bubnov, V. P.; Bunin, E. N.; Shirya'eva, N. M.; Averki'ev, V. N. 16 Nov 1973. Translated from pp 69-74 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The results of an investigation of the parameters of thermodynamic cycles and an estimate of the dimensional characteristics of heat-exchange equipment for fast reactors using N_2O_4, He, and CO_2 as coolants and working substances are presented. (JWR)

31228 (JPRS-60560, pp 79-83) BINARY CYCLES OF ATOMIC POWER PLANTS WITH FAST SODIUM REACTORS USING A DISSOCIATING COOLANT AND WORKING SUBSTANCE (EUTECTIC MIXTURE OF ALUMINUM CHLORIDE AND BROMIDE) OF THE FIRST WORKING LOOP (Na-EUTECTIC MIXTURE – H_2O). Kalafati, D. D.; Borovikova, A. M. 16 Nov 1973. Translated from pp 91-96 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The thermodynamic properties of an aluminum chloride–bromide eutectic mixture were calculated in order to study the possibility of using this eutectic mixture as the working substance and upper loop coolant in a binary nuclear power plant with a sodium–eutectic mixture – H_2O circuit. The results are discussed and used to estimate the efficiency of such a power plant. (JWR)

31229 (JPRS-60560, pp 196-207) ZONAL PROFILING OF ENERGY RELEASE IN A NUCLEAR REACTOR. Kukha'ev, A. I.; Silko, P. P. 16 Nov 1973. Translated from pp 212-223 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolant and working substances of atomic power plants.

A method for the zonal profiling of energy release in a reactor core is formulated. Calculations are then performed for a two- and three-zoned reactor to test the method. The reactor chosen was a 1000-MW gas-cooled fast reactor with a core volume in the following ratio: 0.48 oxide fuel, 0.19 structural steel, and 0.33 coolant. (JWR)

31230 (JPRS-60560, pp 208-211) SOME DISTINCTIVE FEATURES IN PLANNING PROTECTION AGAINST THE RADIATION OF GAS-COOLED (N_2O_4) FAST REACTORS. Shchekin, Yu. K.; Guskina, L. N.; Tkachenko, S. E. 16 Nov 1973. Translated from pp 224-228 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

Some of the special requirements in the development of biological shielding for N_2O_4 cooled fast reactors are discussed. (JWR)

31231 (KFK-1273-3) FAST BREEDER PROJECT. Third Quarterly Report, 1973. Hueper, R. (Comp.). (Kernforschungszentrum Karlsruhe (F.R. Germany)). Dec 1973. 168p. (In German). (EUR-4971-d). Dep. NTIS (U.S. Sales Only) $11.50.

Information on the development of the LMFBR in the German Federal Republic and in particular the development of the SNR 300 reactor is presented concerning fuel rod and materials development; reactor physics; and reactor safety. (DCC)

31232 (KFK-1814) DESIGN, IRRADIATION, AND EXAMINATION OF THE UO_2-PuO_2 FUEL PINS IN THE TEST DFR-304. Kummerer, K.; Geithoff, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jan 1974. 151p. (In German). Dep. NTIS (U. S. Sales Only) $10.75.

Within the fuel pin development for fast breeder reactors the irradiation experiment DFR-304 comprises the irradiation of 3 fuel pins with UO_2-PuO_2 fuel and a stainless steel cladding in the fast flux of the NaK cooled Dounreay Fast Reactor. The design of the pins with respect of composition and geometry as well as of operational conditions was to some extent representative for a prototype fast reactor like SNR-300. The pin diameter was 6.35 mm. The cladding had a wall thickness of 0.40 mm. The pellet fuel had a smeared density of 80% of the theoretical value. The pin length, however, was only a fraction of real breeder pins. But the ratio of fuel volume to fission gas plenum was again typical. This irradiation experiment primarily is to be considered as a precursor of the bundle irradiation DFR-350, which afterwards took place in the central hexagon of the DFR. The 3 pins were assembled in a socalled "trefoil" which was inserted into a fuel position of the DFR. The maximum linear rod power at start of irradiation was a little above 500 watts/cm. The (calculated) maximum temperature at the clad inner surface was about 670°C. The really achieved local maximum burnup of 56,000 MWd/t M surpassed the target burnup slightly without any pin irregularity. The entire irradiation experiment including all data and facts concerning the experimental objectives, the pin design and specifications, the fabrication of the pins and the preirradiational tests, the irradiation history and, finally, the nondestructive and destructive post irradiation examination is documented. The most important result of the experiment was the operational proof under fast breeder conditions for this pin type. Consequently, the way was open for further irradiations with larger numbers of pins in the Dounreay Fast Reactor. (auth)

31233 (KFK-1880) CALCULATION OF NEUTRON FLUX IN OUTER CORE AND BLANKET REGIONS OF FAST REACTORS. Lalovic, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1973. 125p. (In German). Dep. NTIS (U. S. Sales Only) $9.25.

The effort needed to calculate neutron flux in the outer core and blanket regions of fast reactor assemblies to sufficient accuracy was investigated. The following questions were considered: (1) Is experience concerning the number of space mesh points used in the core-calculations also appropriate for the blanket. (2) How many weighting spectra are necessary to construct zone-dependent group constants for the blanket region. (3) What is the role of the fine structure in the weighting of group constants. The effect of considering transport theory in calculating the neutron flux in outer core and blanket regions was determined by a comparison of S_N and diffusion calculations. To check the reliability of the S_N results, they were compared with independent Monte Carlo methods of transport theory. The influence of reflector on the neutron flux in outer regions was studied. For these studies, a model of a 300 MW(e) sodium cooled fast reactor was used. Furthermore, the possibility of simulating core and blanket regions of a fast reactor in a subcritical assembly with an external source was tested. (GE)

31234 (KFK-1914) SODIUM EXPERIMENTS RELATED TO LOCAL BLOCKAGES IN FAST REACTOR SUBASSEMBLIES. Schleisiek, K. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Feb 1974. 129p. (In German). Dep. NTIS (U.S. Sales Only) $9.50.

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

Local coolant disturbances in fuel elements of sodium cooled fast reactors are of major importance to reactor safety. Since the experimental investigation of such disturbances in full scale bundles of high performance electrical heaters will be possible only in a few years time, preliminary experiments were performed in a simpler test assembly. It consists of an induction heated tube with a concentric displacer whose profile generates parallel subchannels interconnected so as to form an annulus. The dimensions of the sub-channels largely correspond to those of the fuel element. Part of the cross section is closed by a plate to simulate local cooling channel blockages. This reduces cooling to such an extent as to generate major local increases in temperature and boiling of the coolant. The temperature distributions measured behind the blockage are subjected to a detailed analysis. A semi-empirical convection model is developed which approximately describes the relationship between the increase in temperature, the residence time of the coolant in the recirculation zone behind the blockage, and the size of the blockage. The comparison of the measurements performed with water and sodium under the same conditions prove that with blockages of the size investigated the energy transport is controlled more by convection than by any other transport mechanism. Accordingly the temperature distributions measured can simply be converted to sodium. Application of the model to SNR fuel elements shows that the increase in temperature generated by major blockages (>40%) is probably lower than has so far been assumed. The experiments were compared with results predicted by the local boiling model developed by K. Gast. 49 references. (auth)

31235 (LA-UR-74-520) RECRITICALITY CONSIDERATIONS IN LMFBR ACCIDENTS. Boudreau, J. E.; Jackson, J. F. (Los Alamos Scientific Lab., N. Mex. (USA); Argonne National Lab., Ill. (USA)). 1974. 25p. (CONF-740401-3). Dep. NTIS $4.25.

From conference on fast reactor safety; Los Angeles, California, USA (2 Apr 1974).

Recent studies suggest that fuel which is dispersed upward by a mild prompt critical burst may reenter the core region causing a secondary excursion. Several modes of fuel reentry recriticality are examined, and phenomena which strongly affect reactivity ramp rate estimates are evaluated. A broad range of ramp rates results from these studies. The results also indicate that a number of effects expected to be present in realistic situations can strongly mitigate the expected reactivity insertion rates. (29 references) (auth)

31236 (NIIAR-P-176) CALCULATION OF THE BOR-60 REACTOR ASSEMBLY COOLING IN GASEOUS MEDIUM. Antipin, G. K.; Kondrat'ev, V. I.; Masnyi, V. F.; Timchenko, V. P. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1972. 36p. (In Russian). INIS.

Cooling shutdown of the reactor assembly BOR-60 in gaseous medium was calculated. The calculation method, program, results of the experimental investigation on a working assembly model, comparison of experimental with calculation, and results of the calculation of the temperature field in the assembly during different power of the residual energy extraction and different gas consumption through the assembly were reported. (tr-auth)

31237 (ORNL-TM-4384) ORRIBLE: A SERIES OF COMPUTER PROGRAMS FOR FLOW AND TEMPERATURE DISTRIBUTION IN LMFBR FUEL ROD BUNDLES OF DIFFERENT SIZES AND CONFIGURATIONS. Wantland, J. L. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. 147p. AT.

A series of computer programs named ORRIBLE was written to predict the flow and temperature distribution for steady single-phase flow through bundles of heated rods separated by helical wire-wrap spacers. Any combination of flow subchannels can be blocked at the inlet. The test section can have an unheated entrance length followed by a heated section and an unheated exit length. In the heated section the linear heat rate of each of the rods can be individually specified. Turbulent interaction, sweeping cross flow due to the wire wrap, and transverse thermal conduction are considered. An approximate relationship for pressure-diversion cross flow in terms of local axial mass velocities is used to eliminate pressure as a variable; hence the computational procedure does not require iterative techniques. Eleven versions of ORRIBLE are currently operational for three duct configurations of 19-rod bundles and for 37-, 91-, and 217-rod bundles in hexagonal ducts. For two configurations, the axial heat flux distribution can be specified as a chopped-cosine profile. In three versions, periodic channel area variations due to the wire wraps moving through the channels and the possibility of the rod bundle forming a helix in the duct are considered. (auth)

31238 (RD/B/N-2837) BUBBLING FROM LMFBR FUEL FAILURES AND ITS RELEVANCE TO FAILED FUEL LOCATION. Polley, M. V. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1973. 37p. Dep. NTIS (U. S. Sales Only) $5.00.

Bubbling of gas from LMFBR fuel failures is discussed principally for situations in which the initial high release has subsided and in which the failure is not logged with Ns. The detachment radii of bubbles, emanating from small cylindrical holes into flowing sodium, have been calculated for typical CFR conditions. For holes of radius 5 to 100 microns, bubble radius is calculated to lie in the range 10 to 200 microns. It is shown that the burst cartridge detection signal may fluctuate considerably

when the bubble size is > 50μ. The rate of growth of bubbles forming at the exit of small cylindrical holes in the cladding is investigated. It is concluded that bubble emission will not be steady and that small changes in coolant or fission gas pressure may cause bubble emission to cease for periods comparable with the burst cartridge detection counting time. During a reduction in coolant pressure, emission should be enhanced, for example during power cycling; but this may be either advantageous or disadvantageous for the location of failed fuel in CFR depending on whether the duration of the enhanced emission is less than or greater than the burst cartridge detection cycle time. (UK)

31239 (TID-26487, pp 103-113) BASIS OF FACILITIES DESIGN FOR CLEANING OF PEC REACTOR COMPONENTS FROM SODIUM AND RADIOACTIVITY. Cervellati, A. (CNEN, Bologna); Tomassetti, A. 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

The basic design criteria, the equipment, and the procedures used in the sodium cleaning and decontamination facilities at the PEC reactor are discussed. Washing procedures for different types of components are contrasted. (JWR)

31240 (WASH-1101(2nd Ed.)) LMFBR: LIQUID METAL FAST BREEDER REACTOR PROGRAM PLAN. Element 1. Overall Plan. (Argonne National Lab., Ill. (USA)). Dec 1973. 145p. Dep. NTIS $7.60.

The LMFBR development plan in the U.S. is described. Topics discussed include: program perspective, key program objectives, overall scope and organization, LMFBR support facilities, element scopes and interfaces, and plan preparation. (DCC)

31241 REMOVAL OF HYDROGEN FROM LIQUID SODIUM. Kamei, H.; Ohno, M. (to Nippon Atomic Industry Group Co.). US Patent 3,795,087. 5 Mar 1974. Priority date 3 Aug 1970, Japan. 4p.

Hydrogen is separated from a fluid, particularly molten sodium, by use of a hydrogen selective semipermeable membrane. A method is provided whereby the membrane is constructed so as to replace a portion of a pipe for containing said molten sodium. In a second embodiment, the method is disclosed whereby a tank for containing said molten sodium, is provided with a hollow tube at least partly constructed with said membrane. (Official Gazette)

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Refer also to abstracts 29139, 29210, 29488, 31205, 31206, 31216, 31294, 31321, 31360, and 31411.

31242 (AD-770115) REDUCTION OF ^{41}Ar ENVIRONMENTAL RELEASES AT RESEARCH REACTORS. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Aug 1973. 14p. (AFRRI-TN-73-9). NTIS $2.75.

The reactor facility at the Armed Forces Radiobiology Research Institute consists of a TRIGA Mark-F reactor with two large walk-in exposure rooms and a pneumatic tube facility. Operation of the reactor adjacent to these rooms results in significant ^{41}Ar production rated due to the high thermal neutron leakage from the core and from the albedo off the walls. The leakage and albedo have been reduced by placing panels painted with gadolinium-loaded paint on the walls and ceiling of the rooms and reactor tank protrusion. Calculations and measurements show that the ^{41}Ar production rate and consequently the effluent release to the environment have been decreased by a factor of 10 to 20, depending on the operational configuration of the reactor. (auth)

31243 (AE-484) NEUTRON RADIOGRAPHY AT THE STUDSVIK R2-0 REACTOR. Gustafsson, L; Sokolowski, E. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Jan 1974. 46p. Dep. NTIS (U. S. Sales Only) $5.50.

Two neutron radiography units have been constructed around the 1 MW swimming-pool reactor R2-0 at Studsvik. The objectives for the first unit were to study the potentialities of neutron radiography and to gain experience of the technique without great investment in equipment. One of the most immediate applications envisaged was the inspection of irradiated fuel rods. These objectives were met by a facility immersed in the reactor pool, the water serving as a radiation shield. The pool unit, although cheap and well suited for fuel rod inspection, has several serious drawbacks, such as limited object size and geometry, poor accessibility and a high gamma background. For this reason, and because of the potentialities of neutron radiography outside the fuel inspection field, another facility was installed in one of the beam holes through the concrete shield of the reactor. Among the characteristics of this facility are a continuously variable aperture, a high neutron-to-gamma ratio and a soft neutron spectrum. Despite a considerable effort to reach different categories of potential customers, the demand for neutron radiography service comes almost exclusively from the nuclear-energy sector. In connection with test irradiations of nuclear fuel in the R2 reactor, neutron radiography has become a routine procedure. (21 references) (auth)

31244 (AECL-4364) URANIUM BOOSTER ROD EXPERIMENTS IN ZED-2. Part II. Initial Conversion and Fast Fission Ratio Measurements for a 20% Enriched Uranium Booster Rod. Mehta, S. L.; French, P. M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1973. 43p. Dep. NTIS (U. S. Sales Only) $5.25. AECL $1.00.

Initial conversion ratio and fast fission ratio experiments were performed in the ZED-2 critical facility with a D_2O cooled, 61-element, 19.91 wt % ^{235}U partially enriched U-Al booster (4.74 g ^{235}U/cm length). Measurements were performed in two lattices with the booster located interstitially, parallel to the reference lattice 28-element natural UO_2 fuel assemblies. The results indicate that the initial conversion ratio is not insignificant and ^{238}U resonance absorption effects must be considered in design studies using partially enriched uranium boosters. (auth)

31245 (ANCR-1129) NUCLEAR TECHNOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1973. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Dec 1973. Contract AT(10-1)-1375. 410p. Dep. NTIS $10.60.

Technical programs of the Nuclear Technology Division of Aerojet Nuclear Company for the year ending June 30, 1973, are described. Abstracts or expansions of abstracts of published papers appear, as well as results of work in progress. Separate abstracts were prepared for the sections on reactor development and for articles on nonnuclear energy sources. Each of the articles on nuclear properties containing significant information was separately title listed. (RWR)

For abstracts of individual sections see: 29603, 30767–30769, 30798–30802, 30820, 31246–31250, 31444, and 31445.

31246 (ANCR-1129, pp 79-125) GENERAL REACTOR DEVELOPMENT AND SUPPORT. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

Data are presented on spectrum calculations for the Coupled Fast Reactivity Measurement Facility (CFRMF), fission product reactivity measurements in CFRMF, dosimetry reaction rate measurements in CFRMF, spectrum determinations in EBR-II, gas core reactor design, and gas core reactor flow studies. (JWR)

31247 (ANCR-1129, pp 127-173) TEST REACTOR OPERATIONS SUPPORT. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

Program activities in support of the Advanced Test Reactor, the Engineering Test Reactor, and the Advanced Test Reactor Critical Facility are reported. (JWR)

31248 (ANCR-1129, pp 175-217) LOFT SUPPORT. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

The development and testing of instrumentation for the LOFT facility are summarized. (JWR)

31249 (ANCR-1129, pp 219-245) PBF SUPPORT. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

Activities in support of the PBF project included a reliability analysis of the plant protection system modifications, refinements in data collection and processing equipment and methods, instrumentation development, analysis of control rod drive latch mechanism, and reactor physics studies. (JWR)

31250 (ANCR-1129, pp 247-265) FEFPL SUPPORT. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

Activities in support of the Fuel Element Failure Propagation Loop (FEFPL) project included development of a data acquisition system, seals development, development of monitoring equipment, and preparation for tests in the ETR. (JWR)

31251 (BNWL-B-341) PRELIMINARY SAFETY ANALYSIS REPORT FOR THE PNL NEUTRON MULTIPLIER FACILITY. Hall, R. J.; Rieck, H. G. Jr. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-1830. 68p. Dep. NTIS $6.50.

The design, operation, and safety of the Neutron Multiplier Facility (NMF) at the Pacific Northwest Laboratories are discussed. The NMF will provide thermal neutrons for irradiation of two basic types of samples, i.e., environmental samples and a 4 gram maximum sample of fully enriched uranium. The latter will be used to produce fission products for on-line mass spectrometry. The Neutron Multiplier will produce thermal neutrons by fission multiplication and subsequent moderation of neutrons from a ^{252}Cf source. The NMF is designed for use of a 100 mg ^{252}Cf source. The fuel for the neutron multiplier is 93% ^{235}U enriched uranium. The thermal neutron flux available from the neutron multiplier will be of the order of 10^{10} neutrons/cm^2 sec. The NMF will be a subcritical facility. Under normal operating conditions the neutron multiplier will have a k_{eff} in the range 0.92 to 0.97 depending on irradiation tube configuration and sample characteristics. The neutron multiplier will be located at the bottom of a 20 foot deep pool of water. Physical barriers will prevent rearrangement of fuel. The nuclear parameters of the neutron multiplier are such that no temperature or water density (voiding or flooding) effects can result in criticality. It is concluded that the NMF can be built and operated without creating an unacceptable risk to either operating personnel or the public. (LCL)

31252 (CONF-730465-, pp vp. V. 6, Paper 622) MECHANICAL INTEGRITY MONITORING OF HIFAR REACTOR FUEL ELEMENTS. Harris, R. W.; Winsbury, G. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Two techniques have been developed for monitoring the mechanical integrity of HIFAR (High Flux Australian Reactor) fuel elements. One is a mechanical signature analysis technique which can determine the integrity of an element prior to use in the reactor. The other technique uses noise analysis applied to vibration signals obtained external to the reactor core, to provide on-line monitoring of the characteristic response of the fuel elements to coolant flow induced vibrations. (auth)

31253 (EUR-5044) COOLANT VOID EXPERIMENTS IN ECO IN 19 ROD U AND U–Pu FUEL CLUSTERS. Hage, W.; Hettinger, H.; Hohmann, H.; Tinagli, F.; Toselli, F.; Schneider, H. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1974. 29p. Dep. NTIS (U. S. Sales Only) $3.50. EUR B. Fr. 40.-.

Critical height variations of the D_2O moderated critical facility ECO as function of coolant void were measured. The void was generated in a test section of the central fuel element. The aim of the experiments was to study the void effect in a 19-rod fuel cluster with different isotopic contents of fissile and fertile U and Pu isotopes in the exchangeable fuel rods. The experiments were carried out with 3 coolants (D_2O, H_2O and D_2O–H_2O mixture) at 3 lattice pitches. (8 references) (auth)

31254 (EUR-5081) TEMPERATURE COEFFICIENT MEASUREMENTS IN ECO WITH Pu-CONTAINING ONE AND THREE ROD FUEL ELEMENTS. Hage, W.; Hettinger, H.; Hohmann, H.; Toselli, F.; Schneider, J. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1974. 60p. Dep. NTIS (U. S. Sales Only) $6.00. EUR B° Fr. 85.-.

Channel temperature coefficient measurements were performed in the D_2O moderated natural uranium critical facility ECO. The purpose of these experiments was to determine the critical height variations as function of the coolant channel temperature by the progressive substitution technique with natural uranium and uranium plutonium fuel elements. The D_2O or H_2O coolant of 1, 5, and 9 central elements was heated step by step from 20°C to 200°C. The reactivity effects were measured by two different methods at square lattice pitches between 17.5 cm and 28.05 cm. (auth)

31255 (INIS-mf-1160) FUEL HANDLING AND STORAGE IN THE 100 MW THERMAL RESEARCH REACTOR PROJECT. Ranganathan, H.; Rao, T. K.; Tikku, A. C.; Selvaraj, A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Fuel handling and storage in the proposed 100 MW Thermal Research Reactor are described. It includes (a) assembly, testing and storage of fresh fuel and experimental assemblies (b) installation and removal from the reactor (c) storage and disposal of irradiated fuel and test assemblies. Two vertical fuelling machines, one for heavy water cooled fuel elements and the other for demineralized water cooled experimental assemblies, are used for rod handling. Two flasks are necessary to prevent any possible degradation of heavy water during rod handling. The heavy water fuelling machine is designed to handle rods during reactor operation. For temporary storage of irradiated rods and experimental plugs, a storage block is provided in the reactor hall. From the storage block, the irradiated rods are transferred vertically to the water filled bays in the spent fuel storage building. Fuel section is separated from the fuel rod and shipped in a shielded container for fuel reprocessing. (auth)

31256 (INIS-mf-1161) THERMAL HYDRAULIC ANALYSIS OF FUEL ROD CLUSTER FOR 100 MWt. Venkat Raj, V.; Grover, R. B.; Murthy, L. G. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Computer programs HECTIC and COBRA are used to evaluate the sub-channel coolant temperatures and surface temperatures in fuel rod clusters of various dimensions and configurations. The analysis was carried out for different values of the various parameters such as coolant velocity, eddy diffusivity adjusting factor etc. The results of the analysis and the conclusions derived are discussed. The programs are used to carry out the thermal hydraulic analysis of the 7 rod fuel bundle proposed for the 100 MW(t) research reactor. (auth)

31257 (INIS-mf-1163) CONTAINMENT AND VENTILATION SYSTEM FOR THERMAL RESEARCH REACTOR. Narasinga Rao, S. N.; Gulati, V. N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 6p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The containment and ventilation system for the proposed 100 MW thermal research reactor is discussed. Concrete containment with cylindrical shell and spherical segmental dome will be provided to withstand an internal pressure of 4 psig. Reactor hall will be supplied with conditioned air to give one air change per hour and will be maintained at a positive pressure of 0.25'' w.g. Spent fuel storage building will be supplied with filtered air to give 6 air changes per hour and will be maintained at a negative pressure of 0.25'' w.g. to prevent leakage of active air to atmosphere. Air from both the buildings will be exhausted through high efficiency absolute filters before discharging to atmosphere through a stack 85 M high. Iodine filters will be provided to prevent release of radioactive iodine. (auth)

31258 (IS-T-628) APPLICATION OF MONTE CARLO CRITICALITY CALCULATIONS TO THE AMES LABORATORY RESEARCH REACTOR. Hull, D. L. (Ames Lab., Iowa (USA)). Apr 1974. Contract W-7405-eng-82. 72p. Dep. NTIS $6.75.

Thesis.

The modeling of the Ames Laboratory Research Reactor core region and the input required to utilize the Monte Carlo computer code KENO for criticality calculations are described. Reactivity calculations in terms of k-effective were made for various reactor configurations and compared to measurements made on the actual reactor. (16 references) (auth)

31259 (JPRS-60560, pp 189-195) EXPERIMENTAL STUDY OF SOME TECHNOLOGICAL QUESTIONS IN THE APPLICATIONS OF N_2O_4 COOLANT IN A NUCLEAR REACTOR. Sokol'chik, V. A.; Nesterovich, E. L; Barkovskii, A. V.; Trubnikov, V. P. 16 Nov 1973. Translated from pp 205-211 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The PGZh-1 installation at the IRT-2000 research reactor is described. PGZh-1 contains an in-pile N_2O_4 coolant loop designed for studying the radiation and heat resistance of N_2O_4, for testing of construction materials, and for obtaining experience in the operation of an N_2O_4 cooled facility. Some of the experiments are reviewed. (JWR)

31260 (JUL-1031-RG) NOISE ANALYSIS AT ITR (INCORE-THERMIONIC-REACTOR) DETERMINATION OF β/l AND POWER DETERMINATION USING THE FORMFACTOR. Malka, V.; Brixy, H.; Hecker, R. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Dec 1973. 65p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

Reactor physical parameters such as the prompt decay constant, the life time and the absolute power of the reactor were determined at the critical assembly ITR by noise analysis. This was done by analysis of cross-correlation functions of signals obtained from ionization chambers. These functions were calculated on-line and real-time by an analog correlator. Experiments were performed at powers up to 50 watt at 10 different core configurations. To determine the power (accuracy to 2%) a formfactor was applied that took into account the space and energy dependence of neutron flux. 15 references. (auth)

31261 (KFK-1705) REPORT ON THE OPERATION IN 1971 OF THE RESEARCH REACTOR FR2. Steiger, W.; Moeller, I. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Reaktorbetrieb und Technik). Nov 1973. 186p. (In German). Dep. NTIS (U. S. Sales Only) $12.50.

The ten phases of operation (of four weeks duration each except for operating phase B of three weeks duration) proposed in the schedule for the heavy-water moderated research and material test reactor FR2 were largely adhered to in 1971, while achieving a nominal power of 44 MW. During each phase, the reactor was operating for about 30 days and shut down for five days for fuel element loading and unloading, withdrawal and installation of experiments, as well as maintenance and inspection work. The total energy produced amounted to 11.811 MWd. The burnup of the fuel elements, type BE8, with an initial enrichment of 2% and withdrawn according to schedule was increased to more than 14.000 MWd per tonne of uranium. The utilization of FR2 for experiments was the same as in 1970, since practically all experimental positions were occupied. With respect to the capsule irradiations performed within the framework of the Fast Breeder Project a marked reduction could be observed in the number of experimental rigs. New tasks related to the irradiations of fuel element plates for Physikalisch-Technische Bundesanstalt (PTB) and a thermionic emitter of the Siemens company. Of the usable beam holes, only the beam hole outlet R6 was not used. (auth)

31262 (LMEC-TDR-74-4) DEVELOPMENT AND TEST OF FFTF PROTOTYPE FAST RESPONSE PRESSURE TRANSDUCER. Twa, G. J. (Atomics International, Canoga Park, Calif. (USA). Liquid Metal Engineering Center). 1 Feb 1974. Contract AT(04-3)-700. 74p. AT.

The results are reported of the development and test of a fast response pressure transducer using NaK as a transmission fluid to transfer the pressure from a heated area to a cooler environment in which the transducer can operate. Response time tests were conducted on a 50-ft capillary unit. A burst-diaphragm apparatus was used to provide the step change in pressure. Test results showed a damped natural frequency of 23 Hz. (auth)

31263 (NIIAR-P-194) FUEL CONSUMPTION AND COST DEPENDENCE ON PARTIAL FUEL RELOADING IN RESEARCH REACTORS. Tsykanov, V. A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 22p. (In Russian). INIS.

An analysis was made of the fuel consumption and the corresponding costs as a function of the fuel reloading in high-flux reactors of the trap type. It was shown that the fuel consumption and the corresponding costs vary as a function of the fuel cost, fuel element manufacture, and regeneration of the spent fuel and also as a function of the loss fraction during regeneration and fuel reloading in the reactor. Partial reloading substantially reduces the fuel consumption and its cost. In all cases optimum burnup of the fuel takes place and therefore its total consumption and corresponding costs are at a minimum. Relations were derived which can be used for the determination of the optimum characteristics of the reactor (effective volume of the active zone and relative fuel burnup), minimum fuel consumption, and its costs. (tr-auth)

31264 (PWAC-324) PRELIMINARY HAZARDS REPORT FOR A REACTOR EXPERIMENT AT NRTS, JULY 1960. Bigelow, C. C.; Hedden, D. T.; Crume, E. C. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1 Apr 1961. Contract AT(11-1)-229. 321p. Dep. NTIS $19.25.

Declassified 20 Sep 1973.

This report is submitted to the Atomic Energy Commission for review by the Advisory Committee on Reactor Safeguards and Hazards Evaluation Branch to obtain approval to proceed with final design and construction of a nuclear reactor test facility at the National Reactor Testing Station (NRTS) in Idaho. The purpose of the report is to demonstrate that a 10 MW reactor test system can be operated safely in the proposed facility with acceptably small risk to the public. The proposed 10 MW reactor experiment is to be conducted by Pratt & Whitney Aircraft as a major step in the development of an aircraft nuclear powerplant. Preliminary design criteria have been prepared for modifying the Initial Engine Test (IET) facility to provide a technically adequate and safe facility for this purpose. The new facility, called the Reactor Test Facility (RTF), differs from the previously proposed Connecticut Aircraft Nuclear Engine Laboratory (CANEL) facility in its geographical location, elimination of the containment vessel, installation of the test system on a rail-mounted dolly and the introduction of a separate Assembly Building and Hot Shop connected to the test facility by a rail system. 51 references. (auth)

31265 (PWAC-341) CANEL INPILE FORCED CONVECTION LOOP PROGRAM SUMMATION REPORT. Fine, A. M. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Jun 1961. Contract AT(11-1)-229. 148p. Dep. NTIS $10.50.

Declassified 20 Sep 1973.

The Pratt & Whitney Aircraft Forced Convection Inpile Loop was the result of an extensive program undertaken as a part of the over-all effort in the development of a nuclear powered airplane. One of the major problems to be overcome in this development was the design of a suitable reactor fuel element. The inpile loop was conceived as a vehicle for the testing of prototype and development stage fuel element specimens under dynamic conditions in a radiation environment. A description of the inpile loop design and the reasoning behind certain design features which serve to make this experiment unique are presented. Descriptions of the two types of fuel elements tested, as well as the gross details regarding their method of manufacture, are included. Four of the major test programs, including the hydrodynamic testing and pump development, the motor and bearing development, the out-of-pile test, and the Engineering Test Reactor Critical Facility (ETRC) critical mock-up test are described. The importance and specific results of each test program are presented. A section on the inpile testing of the two PW 19 Inpile Loops is included with a discussion of the test operation. The final section contains the results of the post irradiation examination of the two inpile loop experiments. 38 references. (auth)

31266 (SLA-73-998) SANDIA PULSED REACTOR III (SPR III): PROTECTION-SYSTEM DESIGN BASIS. Bonzon, L. L.; Philbin, J. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 27p. Dep. NTIS $4.50.

The design bases are discussed for each of the three major modes of SPR III operation: steady-state, pulse, and delayed-tail. Discussion about selection of the design bases for a particular mode of operation is included in the pertinent section, together with a summary of the design bases themselves. Discussion pertinent to all modes of operation appears as an appendix and is referenced in the appropriate section. 22 references. (auth)

31267 (SLA-74-5144) REACTOR KINETICS: PULSE AND STEADY-STATE. Estes, B. F.; Morris, F. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1974. 16p. (CONF-740206-3). Dep. NTIS $4.00.

From Triga owner's conference; Albuquerque, New Mexico, USA (25 Feb 1974).

An analytical model has been developed which combines the nuclear and thermal characteristics of the Annular Core Pulse Reactor into a solution describing both the neutron kinetics of the reactor and the temperature behavior of a fuel-moderator element. The model describes both pulse and steady-state operations. (auth)

31268 (TID-26487, pp 15-26) SODIUM REMOVAL AND DECONTAMINATION EXPERIENCE ON RAPSODIE. de Fremont, R.; Girault, J. M.; Levillain, C. (CEN de Cadarache, St.-Paul-les-Durance, France). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

Experience gained in operating the sodium removal and decontamination facilities at the RAPSODIE Reactor is summarized. The performance of the facilities for the handling of both large and small components is described. (JWR)

31269 (TID-26487, pp 205-212) EXPERIENCE IN LIQUID METAL DECONTAMINATION ON THE DFR PLANT. Kirk, J. (United Kingdom Atomic Energy Authority, Dounreay, Scotland). 1973.

In specialists meeting of decontamination of plant components from sodium and radioactivity, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, 9–12 April 1973.

The liquid metal decontamination facility at the Dounreay Fast Reactor is described. Experience in cleaning techniques gained from the operation of the facility is reviewed. Modifications to the facility made as a result of the operational experience are discussed. The decontamination pit constructed for larger and highly radioactive components is described. The decontamination of fuel elements is discussed in some detail. (JWR)

31270 (WARD-2171-40) FAST FLUX TEST FACILITY. Quarterly Progress Report for the Period Ending November 30, 1973. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1973. Contract AT(45-1)-2171. 46p. AT.

Research and development activities for the FFTF reactor are reported under the following headings: reactor systems and components; heat transport system; instrumentation and control com-

ponents; plant mechanical components; FFTF safety analysis; and FFTF materials application and component testing. (DCC)

31271 (ZFK-244) EVALUATION OF RESEARCH REACTOR SAFETY ON THE BASIS OF STATISTICAL TREATMENT OF LITERATURE INFORMATION. I. Density Distributions of the Excess Reactivity and Shutdown Margin as a Function of the Reactor Power. Adler, B.; Kampf, T. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Feb 1973. 26p. (In German). Dep. NTIS (U.S. Sales Only) $4.50.

The excess reactivity and shutdown margin as a function of the reactor power and of other reactor parameters will be considered on the basis of literature information. The visual consideration of these distributions shows that it will be possible to lay out safely the considered parameters from the viewpoint of reactor safety. (auth)

31272 NEUTRON COUNTING CHANNEL WITH HIGH TIME RESOLUTION. Behringer, K.; Phildius, J. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Nucl. Instrum. Methods; 116: No. 1, 45-53(1974). (In German).

For reactor-kinetic studies a high-resolution neutron counting channel equipped with a fission counter detector was developed. It processes pulse-rates up to 10^7 cps, whereby dead-time losses at that counting rate are 12%. The designed pulse amplifier has a rise-time of 2 ns with a current gain of 2.4×10^3. (auth)

31273 PRODUCTION OF DCA PLUTONIUM FUEL. Muto, T. (Power Reactor and Nuclear Fuel Development Corp., Ibaraki, Japan). Doryokuro Giho; No. 7, 55-68(Apr 1973). (In Japanese).

Production of plutonium fuel for DCA (D_2O Critical Assembly) is reviewed. The outline of the "ATR line" in the PNC's plutonium production plant at Tokai factory is described. The production rate is now 5 tons/year and is scheduled to be extended to 10 tons/year next year to meet the demand for "Fugen". 15 glove boxes are sued for the production of fuel pellets. The batch size for DCA fuel is about 27 kg. The arrangement and function of each glove box are shown. The facilities for the production and inspection of fuel rods (2m long) are also explained. The production rate is 15 rods/day. Specifications of (Pu, U) O_2 pellets are shown. Plutonium enrichment (0.54 and 0.87 wt %), permissible amount of impurities, O/M ratio, densitv, dimensions, and appearance of the pellets are given. Specifications are also given for the fuel rods and for fuel assemblies. The structure of the fuel assembly is shown. The process of pellet and rod production, inspection and recovery is explained in detail. The distributions of pellet diameter and density are shown in the form of computer output. Finally, many problems encountered in the process of production are discussed. Reasons for rejected pellets were, in the order of high rate of occurrence, density, appearance, radius and plutonium enrichment. Most of the rejected fuel rods were detected by x-ray inspection applied to welded part. (JA)

31274 TEXTURE AND IRRADIATION GROWTH IN EBR-II DRIVER FUEL. Strucken, E. F. (Du Pont de Nemours and Co., Aiken, SC); Walter, C. M. J. Nucl. Mater.; 50: No. 1, 69-82 (Feb 1974).

Preferred-orientation studies of centrifugally bonded EBR-II fuel pins showed that the pins have an axial texture characterized by a preponderance of [001] and [110] poles and a deficiency of [021] poles. This texture is responsible for their diametrical growth and shortening in length during irradiation. The growth indices calculated from the texture data correlate well with the observed diametrical irradiation growth rate of the pins and give a single-crystal growth rate, g, of 430% per percent burnup, which is in the range measured for uranium and uranium alloys. The texture is shown to be caused by compressive stresses from centrifuging during the $\gamma \rightarrow \alpha$ transformation of the fuel pin at 500°C. Atomistic mechanisms for the texture formation produced by the compressive stress are discussed. (10 figures, 3 tables, 25 references) (auth)

31275 MAGNETICALLY PULSED NEUTRON TIME-OF-FLIGHT SPECTROMETER FOR INELASTIC SCATTERING. Mook, H. A.; Snodgrass, F. W.; Bates, D. D. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 116: No. 2, 205-216(1974).

A time-of-flight spectrometer utilizing a magnetically pulsed beam has been placed in operation at the High Flux Isotope Reactor at the Oak Ridge National Laboratory. The pulsing is accomplished by rapidly changing the magnetic moment direction in a ferrite crystal that serves to both monochromate and pulse the beam. Good neutron reflectivity is obtained from the ferrite crystal and pulse risetimes of the order of 1 μs are available. The spectrometer is interfaced to a Digital Equipment Corporation PDP-15-30 computer which drives pulsed motors to set up the desired scattering geometry and collects and analyzes the time-of-flight data. The magnetically pulsed beam is ideal for use with the cross-correlation technique and spectra are presented which show the accuracy of the pulsing technique and the power of the cross correlation methods in obtaining neutron scattering data. (auth)

31276 ARGON-41 MEASUREMENTS AT A POOL REACTOR. Jones, J. D. (Univ. of Michigan, Ann Arbor). pp 1043-1066 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

An accurate, inexpensive, continuous air monitoring device for measuring argon-41 and other radioactive noble gases has been constructed from a 55-gallon drum and a Geiger-Mueller counter. Argon-41 concentrations in the building air and the exhaust stack effluent are of primary interest. Radon progeny and other particulate contaminates are filtered by a membrane filter before the air enters the drum. Background variations are minimal. Simple calibration procedures are outlined. The sensitivity of the monitor is sufficient to determine concentrations less than 2% of the occupational MPC_a for ^{41}Ar. ^{41}Ar activity increases in the reactor building were correlated with the bulk pool water temperature. The occasional absence of detectable ^{41}Ar activity was attributable to thermal layers in the pool. The effect of a calorimetric calibration of the reactor on argon released is described. ^{41}Ar concentrations in the discharge stacks were correlated with reactor core configuration near the pneumatic sample tube system. Four years experience with the device at a 2 megawatt pool-type research reactor are summarized. (auth)

31277 MONITORING OF GASEOUS EFFLUENTS FROM REACTORS. Johns, T. F. pp 1067-1078 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

Methods used at the Atomic Energy Establishment, Winfrith, for continuously monitoring gaseous radioactive effluents from reactors are described. The most significant components which may be present in such discharge are radionuclides which affect the general public through contamination of milk (I 131) and gases which lead to exposure mainly through submersion in a cloud of the gas (e.g., noble gases). The problem of monitoring for small (millicurie) releases of I 131 in the presence of much larger quantities (hundreds of curies) of other gases is discussed, and details are given of the techniques adopted for overcoming these difficulties. Experience of monitoring both types of discharge is described. Gross measurements have been made to confirm that releases are acceptably small, and in addition a number of detailed investigations (including in-situ gamma spectrometry with sodium iodide and lithium drifted germanium detectors) have been made in order to establish the composition of the released gases. (auth)

Propulsion and Package Reactors

Refer also to abstracts 29968, 29978, 29985, 29988–29990, 30091, 30165, 31246, 31264, 31265, 31372, 31374, and 31419.

31278 (ACNP-62015-A) MOBILE ENERGY DEPOT FEASIBILITY STUDY: SUMMARY REPORT. Burwell, S. B.; Carlson, J. A.; Clark, R. G.; Donelan, L. E.; Erwin, A. F.; Grimes, P. G.; Jasinski, R. J.; Kruzic, T. P.; Manion, J. P.; Rohowetz, S. E.; Sollenberger, C. L.; Thompkins, J. F. (Allis-Chalmers Mfg. Co., Milwaukee, Wis. (USA). Atomic Energy Div.). 13 Jul 1962. Contract AT(30-1)-2931. 317p. Dep. NTIS $18.00.

Declassified 28 Aug 1973.

Various methods of producing and using nuclear power for military land vehicles and other military equipment were investigated and evaluated. A nuclear-powered mobile energy depot (MED) would move with advancing armies and produce vehicle fuels from materials readily available in the field. This would make mechanized units independent of external fuel supplies for extended periods, and permit them to move quickly and easily to areas impossible for units that depend on the customary fuel supply lines. Many possible MED systems were evaluated on the basis of energy sources, fuel manufacturing (by both conventional and chemonuclear processes), fuel storage and transportation, and fuel utilization in both present-day internal-com-

bustion engines and power units of the future (i.e., fuel cells). The applications of more than a dozen MED systems to vehicular propulsion were studied. (auth)

31279 (CNLM-4257) REACTOR CONCEPTUAL DESIGN STUDIES APPLICABLE TO SNAP-50. Levengood, J. L.; Fultonberg, D. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Nov 1962. Contract AT(30-1)-2789. 32p. Dep. NTIS $4.75.

Declassified 6 Sep 1973.

The results are presented of a study conducted for the purpose of generating concepts and ideas applicable to the SNAP-50 system. Spherical and spherized cylinder cores, (cores in the form of cylinders with hemispherical ends) were investigated because of their inherent minimum core size. The reactor pressure vessel and core support structure for these cores were also investigated. In addition, reactor control schemes, compatible with the basic requirement of simplicity, such as movable radiation cooled reflectors and radiation cooled poison drums, were investigated. Many design concepts studied are compatible with the LCRE type reactor. Investigation of the problems and advantages of various core configurations resulted in the conclusion that regardless of core shape, pin shaped fuel elements and axial coolant flow present the simplest compact core design. A spherized core with fuel pins appeared to offer a potential weight advantage over the cylindrical core. A preliminary reactor design of both rectangular and spherized core shapes was done using a common set of operating conditions so that reactor weights could be compared. Both reactor designs are presented. (auth)

31280 (CNLM-4385) SNAP-50 REACTOR DEVELOPMENT CONCEPT. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 15 Jan 1963. Contract AT(30-1)-2789. 17p. Dep. NTIS $4.00.

Declassified 30 Aug 1973.

Studies of future space power requirements indicate that possible applications of the SNAP-50 powerplant cover a range of power requirements from 150 kW(e) to at least 10 MW(e), and that there are no specific applications in this range which are well enough defined to set the powerplant design requirements. Since a single powerplant design cannot provide optimum performance over the entire power range, it appears desirable to design the powerplant to provide the maximum possible utility in terms of the number and importance of the projected applications which can be accommodated within acceptable performance penalty limits. The reactor development concept described is proposed as a method of increasing the utility of the powerplant, reducing reactor development costs, and increasing reactor reliability in return for a small weight penalty at the lower operating powers. A further increase in utility is offered by the use of the modular power conversion system which is also described. (auth)

31281 (CNLM-4419(Vol. 1)) SUMMARY OF THE SNAP-50 PROGRAM AT CANEL. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 1 Feb 1963. Contract AT(30-1)-2789. 28p. Dep. NTIS $4.50.

Declassified 18 Sep 1973.

31282 (CNLM-4419(Vol. 2)) SUMMARY OF THE SNAP-50 PROGRAM AT CANEL. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 1 Feb 1963. Contract AT(30-1)-2789. 70p. Dep. NTIS $5.50.

Declassified 18 Sep 1973.

Information on the SNAP-50 program at CANEL is presented concerning the LCRE program, SNAP-50-DR-1 program, advanced materials development, and important SNAP-50 development considerations. (DCC)

31283 (CNLM-4423) TECHNICAL BRIEF [OF] SNAP-50 AND LCRE PROGRAMS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 1 Mar 1963. Contract AT(30-1)-2789. 41p. Dep. NTIS $5.25.

Declassified 18 Sep 1973.

Specifications and testing programs for the LCRE reactor are described. LCRE program costs for the development of SNAP-50 systems are presented. (DCC)

31284 (CNLM-5021) SUMMARY OF LCRE FUEL ELEMENT DESIGN INCLUDING SUPPORTING EXPERIMENTAL DATA. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 12 Jun 1963. Contract AT(30-1)-2789. 70p. Dep. NTIS $6.50.

Declassified 18 Sep 1973.

The design basis of the LCRE fuel pin is presented. The fuel pin consists of a Cb-1 Zr alloy cladding tube 0.305 inch diameter, 0.015 inch wall thickness and 35.96 inches long. The active fuel section is 13.5 inches long, with top and bottom reflector rods each 6.9 inches long and with a 4 inch gas accumulation space at each end. The cladding is designed as a pressure vessel to contain the gases released from the fuel and end reflector materials, which results in an internal gas pressure buildup in the pins during reactor operation. (23 references) (auth)

31285 (CNLM-5118) SNAP-50/SPUR FIRST FLIGHT POWERPLANT: PRELIMINARY DESIGN SPECIFICATIONS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 21 Jun 1963. Contract AT(30-1)-2789. 67p. Dep. NTIS $6.50.

Declassified 17 Sep 1973.

31286 (CNLM-5340) SNAP-50/SPUR REFERENCE DESIGN NO. 1. Murphy, J. S. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 9 Dec 1963. Contract AT(30-1)-2789. 79p. Dep. NTIS $7.00.

Declassified 18 Sep 1973.

Analytical and design work was carried out in sufficient detail to define component envelopes, instrumentation and control requirements, electrical wiring, and piping and their arrangements in the SNAP-50/SPUR Powerplant Reference Design No. 1. A spacecraft configuration which is adaptable to the Titan IIIC launch vehicle was selected and design of the powerplant within the spacecraft using the component envelopes was carried out to study the problems associated with the overall integration and define the various interfaces. Use of the Titan IIIC requires that the powerplant mate to a 10 foot diameter at the top of the vehicle. Three configurations were analyzed and a 53 foot long, 10 foot diameter cylindrical envelope with a cylindrical radiator was selected on an overall weight basis. (auth)

31287 (CNLM-5472) PRELIMINARY STUDY OF A 1 MWe UNDERWATER POWERPLANT. d'Arcy, R.; Sinko, G. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 22 Jan 1964. Contract AT(30-1)-2789. 35p. Dep. NTIS $4.75.

Declassified 17 Sep 1973.

The feasibility of adapting the SNAP-50/SPUR type reactor system to a 1 MW(e) powerplant for deep underwater use is analyzed. 6 references. (auth)

31288 (CNLM-5889) SNAP-50/SPUR PROGRAM SUMMARY. (Garrett Corp., Los Angeles, Calif. (USA). Airesearch Mfg. Div.). 1964. 306p. Dep. NTIS $18.50.

Declassified 18 Sep 1973.

The SNAP-50/SPUR is reviewed. The program objectives, assignments, and current status are discussed. (JWR)

31289 (CNLM-5889(Rev. 2)) SNAP-50/SPUR PROGRAM SUMMARY. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). Oct 1964. Contract AT(30-1)-2789. 158p. Dep. NTIS $11.00.

Declassified 19 Sep 1973.

Information is presented concerning the SNAP-50/SPUR development program and test facilities. Current development work includes reactor shielding, liquid metal pumps, reactor components, instrumentation, control systems, reactor materials, and reactor physics. 71 references. (DCC)

31290 (CNLM-6086) SNAP-50/SPUR PROGRAM ANNUAL TECHNICAL REPORT, 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 15 Mar 1964. Contract AT(30-1)-2789. 41p. Dep. NTIS $5.25.

Declassified 31 Aug 1973.

Information on the development of the SNAP-50/SPUR is presented concerning system integration and application studies, reactor and shield design and development, boiler and condenser fabrication, pump design and development, powerplant auxiliary component design and development, major systems test, materials development, and instrumentation and controls development. (DCC)

31291 (DC-60-5-11) INVESTIGATION OF THERMAL SHIELD POISONING EFFECTS ON THE P140B SHIELD. Wysnewski, R. E.; Jacobs, E. P. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). 5 May 1960. Contract AT(11-1)-171. 18p. Dep. NTIS $3.00.

Declassified 13 Sep 1973.

The results of an investigation of boron and gadolinium poisoning in the thermal shield of the P140B third iteration design are presented. Six separate cases were studied in order to determine the effects of various thermal shield poisons on heating rates along a radial traverse in the side shield and on the gamma dose rate at 50 feet out the side. The use of enriched boron only in the pressure pads results in the lowest side shield heating rates of all cases studied. Results also indicate that natural boron in both the thermal shield and pressure pads is a more effective thermal poison than gadolinium. (auth)

31292 (DC-60-6-1) PROJECT 101 QUARTERLY TASK REPORT, APRIL–JUNE 1960. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). Jun 1960. Contract AT(11-1)-171. 405p. Dep. NTIS $22.25.

Declassified 13 Sep 1973.

Information on the design and development of an aircraft propulsion reactor is presented concerning design studies of alternate reactor configurations, selection of reference configuration for D140 power plant, core components, and fuel and other ceramic components. (DCC)

31293 (FXM-4917) HIGH POWER, EXTREME ENDURANCE MOBILE REACTOR CONCEPT WITH AIRCRAFT NUCLEAR PROPULSION POTENTIAL. Johnson, C. W. Jr. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 19 Dec 1960. Contract AT(11-1)-229. 15p. Dep. NTIS $4.00.

Declassified 20 Sep 1973.

A high power (300 MW), mobile reactor is described which offers extreme nuclear endurance potential (over one million MW-hrs) through the use of a moveable core consisting of four partially fueled drums. In addition, optimized pressure drop and heat transfer properties are provided, as well as a practical means of fission gas removal, by use of plates for fuel elements. For immediate application an enriched UO_2–BeO matrix, 140 liter core is suggested which, with an unenriched UO_2–BeO reflector, would be contained in an 18 inch radius spherical pressure shell. 300 MW capabilities are anticipated. Core-reflector size, and consequently shield weight could be significantly reduced by use of UC or ^{233}U as basic fuel materials. (auth)

31294 (GEMP-442) 710 MOCKUP NO. 1 CRITICAL EXPERIMENT. Summary Data Report. Sims, F. L.; Kunze, J. F.; Pincock, G. D.; Chase, P. L. (General Electric Co., Idaho Falls, Idaho (USA)). 21 Oct 1966. Contract AT(40-1)-2847. 200p. Dep. NTIS $12.00.

Declassified 21 Sep 1973.

A summary of the experiments associated with the three uniformly loaded core configurations related to the 710 Mockup 1 Critical Experiment Reactor is presented. These configurations mocked up specific features of the then current 710 reactor experiment design. The experimental areas included initial loading, neutron lifetime, fission ratios, reflector control methods, reactivity coefficients and power distribution measurements. A major portion of the effort was applied to the latter two areas to determine the comparative effects between normally used fuel cells composed of rod-type materials and homogeneous fuel cells using fabricated fuel "compacts". 7 references. (auth)

31295 (GEMP-461) STUDIES OF RADIAL REFLECTOR WORTH DEPENDENCE ON RADIAL COMPONENT PROPERTIES AND ARRANGEMENT IN A FAST-SPECTRUM REACTOR. Zwick, J. W. (General Electric Co., Cincinnati, Ohio (USA)). Nuclear Materials and Propulsion Operation). 16 Dec 1966. Contract AT(40-1)-2847. 75p. Dep. NTIS $6.75.

Declassified 21 Sep 1973.

The evaluation is presented of the dependence of the worth of movable radial reflectors on material composition and radial arrangement of non-core components for the 710 fast-spectrum, refractory-metal reactor design concept. The non-core components are assumed to consist of thermal radiation barriers, pressure vessel, and radial reflector. The effect of a gap between the core and radial reflector is also explored. Beryllium, molybdenum, and Inconel 600 are being considered for the radial reflector; molybdenum, niobium 752 alloy, Inconel 600, and Type 316 stainless steel for the pressure vessel. Design concepts are included that permit convective cooling in the radial reflector, and that exclude convective cooling in the reflector. In the latter case, the generated heat in the radial reflector is radiatively transferred to adjacent components, i.e., the pressure vessel or the envelope shield. (auth)

31296 (GEMP-538) NONDESTRUCTIVE TESTING AS APPLIED IN A REFRACTORY METAL CLAD FUEL ELEMENT DEVELOPMENT PROGRAM. Clark, J. P.; Burgbacher, D. E. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 4 Aug 1967. Contract AT(40-1)-2847. 23p. Dep. NTIS $3.25.

Declassified 21 Sep 1973.

The nondestructive testing program is for both the cladding materials and the finished fuel element assembly for the 710 Reactor. The ultrasonic pulse-echo technique is used to determine the quality of the OD clad-fuel core bond. (DLC)

31297 (GEMP-554) 710 REACTOR THERMOELECTRIC SPACE POWER SYSTEM CONCEPTS. Flitner, D. P. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). Sep 1967. Contract AT(40-1)-2847. 39p. Dep. NTIS $4.00.

Declassified 21 Sep 1973.

A preliminary evaluation of the use of the 710 Reactor in an auxiliary space power system utilizing thermoelectric converters has been performed in order to determine feasibility of the concept and to define the required 710 fuel system operating conditions. Included are results of thermodynamic cycle studies and characteristics of the major components for a range of power levels. Configuration arrangements for man rated and instrument rated 50 kw(e) systems are shown. (auth)

31298 (GEMP-561) 710 REACTOR THERMOELECTRIC SPACE POWER SYSTEM CONCEPTS. Flitner, D. P. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 31 Oct 1967. Contract AT(40-1)-2847. 2p. Dep. NTIS $4.75.

Declassified 5 Sep 1973.

A preliminary evaluation of the use of the 710 Reactor in an auxiliary space power system utilizing thermoelectric converters has been performed in order to determine the potential performance of this concept. Included are results of thermodynamic cycle studies and characteristics of the major components for a range of power levels. Configuration arrangements for man rated and instrument rated 50 kW(e) systems are shown. (auth)

31299 (GEMP-600(Vol.2)) 710 HIGH-TEMPERATURE GAS REACTOR PROGRAM SUMMARY REPORT. Volume II. Reactor, Systems, and Facilities Design. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 1967. Contract AT(40-1)-2847. 204p. Dep. NTIS $13.25.

Declassified 6 Sep 1973.

A summary of the reactor, systems, facilities and test equipment design work performed under the 710 Reactor Program is presented. The reactor and systems design work performed on submarine, rocket, and aircraft propulsion engines based on the 710 Reactor although not funded under the 710 Advanced High-Temperature Gas Reactor Program is also summarized. 88 references. (auth)

31300 (LA-2748) RADIOCHEMICAL MEASUREMENTS ON KIWI-B1A. Summary Report. Sattizahn, J. E.; Knight, J. D.; Cowan, G. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1962. Contract W-7405-eng-36. 112p. Dep. NTIS $7.75.

Declassified 28 Aug 1973.

The techniques and results of radiochemical measurements associated with the KIWI-B1A reactor test of December 7, 1961 are presented. Information is given on total fissions produced, radial and axial fission distribution, temperature distribution, power level, fission products released to the atmosphere, and fission products deposited on the nozzle. (auth)

31301 (LAMS-2482) PRELIMINARY DESIGN STUDY OF KIWI-B TYPE INLET REFLECTOR-CORE SUPPORT STRUCTURES. Rowley, J. C. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1960. Contract W-7405-eng-36. 142p. Dep. NTIS $9.25.

Declassified 28 Aug 1973.

A limited study of several flat-plate core support-reflector combinations and configurations is presented. The major effort is directed toward the determination of plate thicknesses and minimum weights based upon stress-limited designs. The purpose is to provide a basis for possible design directions and methods for actual test device hardware and indications of extensions toward lighter-weight flyable components. Only preliminary design results and comparisons are included; however, areas and problems for detailed design analysis are outlined. 27 references.(auth)

31302 (NASA-CR-54721) REACTOR AND MATERIALS TECHNOLOGY DEPARTMENT QUARTERLY REPORT ON TUNGSTEN–URANIUM DIOXIDE CERMET RESEARCH AND DEVELOPMENT ACTIVITIES: APRIL–JUNE 1965. deHalas, D. R. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1965. Contract AT(45-1)-1830. 120p. Dep. NTIS $9.00.

Declassified 29 Aug 1973.

This R & D program is related to the development of a W–UO_2 fueled, water-moderated space propulsion reactor. Thermal, stress, and dynamic analysis was conducted on lateral fuel support devices. Nondestructive testing techniques were developed to measure total fuel loading and homogeneity of plate and honeycomb grid fuels. (DLC)

31303 (NASA-CR-72031) TUNGSTEN WATER MODERATED REACTOR FUEL SUPPORT DESIGN ANALYSIS. Aase, D. T.; Kempf, T. J.; O'Keefe, D. P.; Townsend, W. C.; Trent, D. S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1966. Contract AT(45-1)-1830. 243p. Dep. NTIS $15.25.

Declassified 29 Aug 1973.

Information on the design analysis of space propulsion reactor fuel supports is presented concerning design concepts, effect of lateral supports on adjacent tubes, stress analysis of corrugated strip lateral support, dynamic analysis, hot end support design, reentrant-flow-cooled lateral support design, and flat plate stock $W-UO_2$ fuel design. (DCC)

31304 (PWAC-180) ALL-NUCLEAR SUPERSONIC BOMBER POWERPLANT CHARACTERISTICS SUMMARY. Gray, W.; Brueger, J.; Larson, J.; Andrews, N. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 3 Jun 1957. Contract AT(11-1)-229. 35p. Dep. NTIS $3.75.

Declassified 12 Sep 1973.

The use of lithium-cooled solid fuel element reactors for an all-nuclear supersonic mission is described. The characteristics of the powerplant, i.e., the reactor power and radiator dimensions, were selected based on the results of an airplane performance study. The criterion on which these were selected is the maximum flight Mach number on the airplane. The heat source of the powerplant is a solid fuel element reactor with a columbium alloy as the structural material. Heat is removed from the reactor by liquid lithium which is piped directly to the engine radiators. At design conditions, with the reactor producing 350 Mw of heat, the lithium enters the reactor at 1350F and is heated to 1650F. The maximum fuel element surface temperature under these conditions is 1700F. The hot lithium temperature of 1650F was selected as being the maximum feasible temperature to use with engine radiators that have stainless-steel-clad copper fins. A higher temperature would require the use of a more oxidation-resistant fin material which would have poorer heat-transfer characteristics. (auth)

31305 (PWAC-187) MINIMUM ALTITUDE NUCLEAR BOMBER POWERPLANT CHARACTERISTICS SUMMARY. Bronke, V.; Gray, W. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 8 Jul 1957. 57p. Dep. NTIS $6.00.

Declassified 20 Sep 1973.

Data on a sodium-cooled two engine power plant for the minimum-altitude mission are presented. The selection of power plant characteristics was based on the criterion of obtaining the maximum speed at sea level consistent with reasonable power plant weight. The heat source for the power plant is a solid-fuel-element reactor of stainless steel construction. Heat is removed from the reactor by liquid-sodium which is pumped through intermediate heat-exchangers where the heat is transferred to the liquid NaK. The liquid NaK is circulated to the engine radiators where the heat is transferred to the engine airflow. The reactor core used for this power plant is identical with that used for the WS-125A power plant study and is capable of producing a maximum power of 250 MW. At this power sodium enters the reactor at 1050F and leaves at 1600F, while the NaK enters the radiators at 1520F and leaves at 900F. For the minimum altitude application, however, the maximum reactor power which the engines are able to absorb is 200 megawatts at a Mach number of 1.2 at sea level. The shielding estimates made for this power plant are consistent with the actual power which the power plant is able to develop. (auth)

31306 (PWAC-188) WEAPONS SYSTEM 125A NUCLEAR BOMBER POWERPLANT CHARACTERISTIC SUMMARY. Brueger, J.; Gray, W. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 1 Jul 1957. Contract AT(11-1)-229. 91p. Dep. NTIS $7.75.

Declassified 4 Sep 1973.

Data on two, three, and four engine powerplants for the nuclear-cruise, chemical-dash, WS-125A mission are presented. The selection of powerplant characteristics, i.e., the reactor power and radiator dimensions, was based on the criterion of the maximum dash penetration radius resulting from an airplane performance study using the four engine powerplant. The heat source of each powerplant is a solid fuel element reactor of stainless steel construction. Heat is removed from the reactor by liquid sodium which is pumped through intermediate heat-exchangers where the heat is transferred to liquid NaK. The liquid NaK is circulated to the engine radiators where the heat is transferred to the engine airflow. At design conditions, the reactor produces 250 MW of heat, and the sodium enters the reactor at 1050F and leaves at 1600F, while the NaK enters the radiators at 1520F and leaves at 900F. (auth)

31307 (PWAC-198) SHIELD OPTIMIZATION CODE. Rost, E. S.; Pomeroy, J. D.; Woodsum, H. C. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1957. 151p. Dep. NTIS $10.75.

Declassified 20 Sep 1973.

A method has been devised and a code written for the IBM 704 computer which will optimize (minimize) reactor and crew compartment total shield weight. Such optimization is based on the gamma and neutron dose rates in the crew compartment being specified values. The basic input required by the code are dose curves at 50 ft for primary gamma rays, secondary gamma rays (those born in the shield), and fast neutrons, vs shield thickness. Also, information is required concerning the system geometry, shielding materials, and mission specifications. The output consists of the optimum shield-thickness distribution, weights of reactor shield and crew compartment shield, and the direct dose pattern around the reactor at 50 ft. (auth)

31308 (PWAC-201) NJ-11A POWERPLANT CHARACTERISTICS SUMMARY. Bronke, V.; Brueger, J.; Gray, W.; Smith, R. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 16 Sep 1957. 59p. Dep. NTIS $6.00.

Declassified 20 Sep 1973.

Data on a two-engine lithium-cooled powerplant for the minimum-altitude mission are presented. The selection of powerplant characteristics was based on the criterion of obtaining maximum transonic speed at sea level consistent with reasonable powerplant weight. The heat source of the powerplant is a solid-fuel-element reactor utilizing a columbium alloy as structural material. Heat is removed from the reactor by liquid lithium piped directly to the engine radiators. The reactor at its design condition is capable of producing 350 MW of heat. For the minimum altitude application, however, the maximum reactor power that the two engines are capable of absorbing on a standard day at the Mach 1.1 sea-level radiator design point is 312 MW. At this condition, the temperature of the lithium entering and leaving the reactor is 1250F and 1650F, respectively. (auth)

31309 (PWAC-217) CHARACTERISTICS SUMMARY OF NUCLEAR TURBOPROP POWERPLANTS. Brueger, J.; Bronke, V. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 2 Jan 1958. Contract AT(11-1)-229. 25p. Dep. NTIS $4.25.

Declassified 20 Sep 1973.

Pratt & Whitney Aircraft is investigating the use of sodium-cooled and lithium-cooled solid fuel-element reactors for several possible manned aircraft applications. Data for two configurations of nuclear turboprop powerplants for application to logistics type airplanes are presented. These powerplants are made up of sodium-cooled solid-fuel-element reactors coupled to nuclear-chemical T57 turboprop engines. The selection of powerplant characteristics was based on the criterion of maximum payload resulting from a logistics airplane performance study. Each of the two powerplant configurations for which data is given has four engines. Powerplant A consists of two, wing-mounted, 60 MW, solid-fuel-element reactors each of which is coupled to two engines. Powerplant B has a single, fuselage-mounted, 120 MW, solid-fuel-element reactor coupled to the four engines. One-half of powerplant A, one reactor and two engines, is considered to be an independent unit. (auth)

31310 (PWAC-242) NJ-12B SUPERSONIC BOMBER POWER PLANT PERFORMANCE CHARACTERISTICS SUMMARY. Gary, W. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1 Apr 1958. Contract AT(11-1)-229. 62p. Dep. NTIS $6.25.

Declassified 20 Sep 1973.

The power plant described is intended for application to a strategic bomber with an all-nuclear supersonic cruise capability. The characteristics of the power plant, i.e., the reactor power, liquid-metal temperatures and radiator dimensions, were chosen on the basis of an airplane study to provide the maximum flight Mach number. The results of the study indicate that the system is capable of speeds exceeding a Mach number of 2.0 at 40,000 feet altitude. The power plant heat source is a stainless steel, sodium cooled fast neutron reactor. The high neutron energy spectrum results in low sodium activation, and permits circulation of the reactor coolant directly to the engine radiators. The need for an intermediate heat-exchanger and its associated equipment is thereby eliminated. At the design condition, the reactor produces 350 MW of heat; sodium enters the reactor at 1250F and leaves at 1650F. The high sodium temperature is the maximum temperature which makes feasible the use of stainless steel as the reactor structural material. (auth)

31311 (PWAC-276) APPLICATIONS OF ADVANCED LIQUID METAL-COOLED REACTORS, APRIL 15, 1959. Gaffin, W. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 22 Apr 1959. Contract AT(11-1)-229. 37p. Dep. NTIS $5.00.

Declassified 12 Sep 1973.

Many possible applications of lithium-cooled, moderated re-

actors have been considered in more or less detail, and several of these applications showed sufficient promise, from a technical standpoint, to warrant further study. Summaries of the characteristics of the more promising applications are presented. (auth)

31312 (PWAC-316) PRELIMINARY INVESTIGATION OF ACCIDENT MECHANISMS OF THE INDIRECT CYCLE AIRCRAFT NUCLEAR PROPULSION SYSTEM. Perry, P. I.; Walton, J. W. (eds.). (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 15 Dec 1960. Contract AT(11-1)-229. 119p. Dep. NTIS $9.00.

Declassified 20 Sep 1973.

The accident analysis of the indirect cycle aircraft nuclear propulsion system considers only the more severe accident conditions. It has been assumed that, in general, the accident analyses performed for the PWAR-11C reactor will pertain for the less severe accident conditions. Since the PWAR-11C reactor is a stationary test reactor operated at 10 MW and identical to the flight reactor, PWAR-11, except for core orificing, it is considered necessary to investigate only those accidents which are dependent upon operating power and those accidents which are possible due to the mobility of an airplane. The configuration of the NJ-18A powerplant, which utilizes twin PWAR-11 reactors, was used in this analysis. 19 references. (auth)

31313 (PWAC-406) STUDY OF ADAPTING THE SNAP-50 SPACE POWERPLANT TO A LUNAR BASE. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 26 Jul 1963. Contract AT(30-1)-2789. 60p. Dep. NTIS $6.00.

Declassified 5 Sep 1973.

The adaptation of the SNAP-50 reactor to an electrical generating system for a lunar base is discussed. The required modifications to the powerplant and special problems peculiar to operation in the lunar environment are described. (JWR)

31314 (PWAC-408) LITHIUM-COOLED REACTOR EXPERIMENT REACTOR OPERATIONS FINAL REPORT. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Jan 1964. Contract AT(30-1)-2789. 112p. Dep. NTIS $7.75.

Declassified 5 Sep 1973.

The Lithium-Cooled Reactor Experiment (LCRE) Reactor Operations Group was organized in the Fall of 1962 and given the responsibility for the safe, efficient operation of the LCRE. Since many, often subtle, aspects of the design of a complex, experimental system such as the LCRE strongly influence the ease, if not the actual feasibility, of its operation, the Reactor Operations Group from the beginning assisted in the design of the LCRE and its auxiliary and support systems. Within a short time, a general operating procedure was outlined, manpower needs were forecast, and recruiting of personnel was begun. Assembly of the voluminous amounts of information, documents, drawings, etc., necessary was started, and the organization and transformation of this material into training programs and operating procedures had commenced. The status of the work accomplished by this group at the time the CANEL SNAP-50 program was reoriented is described. The first drafts of the Fuel Loading Experiment Procedures and the Operator Training Manual, as well as the preliminary outline of the Plant Operating Manual, are included as appendices. (auth)

31315 (PWAC-419) SAFETY SYSTEM LITHIUM-COOLED REACTOR EXPERIMENT. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 24 Dec 1963. Contract AT(30-1)-2789. 7p. Dep. NTIS $8.00.

Declassified 6 Sep 1973.

The solid state electronic logic and preamplifier chassis designed and developed by Pratt & Whitney Aircraft-CANEL for use in the safety system for the Lithium-Cooled Reactor Experiment (LCRE) 10-MW reactor are described. The effective use of dual circuitry, operational test features, modular construction, alarms, and the method of power distribution are also described. The initial tests to determine the compliance of the safety system chassis with the requirements have been undertaken, and results to date have proved the basic designs to be correct. (17 references) (auth)

31316 (PWAC-442) STATUS OF THE SNAP-50/SPUR REACTOR FUELS PARAMETRIC STUDIES. Part II. 2-MW, 8-MW, 10,000-Hour, and 20,000 Hour Reactor Designs. Banach, H. J.; Richings, H. J. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 14 Sep 1964. Contract AT(30-1)-2789. 39p. Dep. NTIS $5.00.

Declassified 6 Sep 1973.

The purpose of the reactor fuel parametric studies presented is to provide guidance in establishing alternate fuel candidates for the first generation reactor, Reference Design No. 4 (this reactor is being designed with 0.95 dense UC/UN fuel for 1.0 percent burnup at 2300°F maximum fuel temperature), look at potential improvement in the SNAP-50 reactor through use of advanced fuels which might be considered for second generation use, and determine required changes in the Reference 4 reactor to extend the design lifetime from 10,000 to 20,000 hours. 6 references. (auth)

31317 (PWAC-445) PRELIMINARY DESIGN OF THE 2 MWt REACTOR AND SHIELD (PWAR-20) FOR THE SNAP-50/SPUR POWERPLANT. Banach, H. J. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Dec 1964. Contract AT(30-1)-2789. 51p. Dep. NTIS $5.75.

Declassified 6 Sep 1973.

The SNAP-50/SPUR powerplant development program concentrates on a system designed for unattended operation in space for 10,000 hours, and which produces a net electrical output of 300 kW(e). The reactor and shield for this powerplant has been designated the PWAR-20. The powerplant weight goal for the 2-MW(t) reactor is 1800 pounds, exclusive of shielding. A target weight for shielding, the design of which is mission oriented, has not been specified because mission requirements have not been clarified to date. The preliminary design of the PWAR-20 is presented. The major problem areas which exist are described. 25 references. (auth)

31318 (PWAC-451) PARAMETRIC STUDIES OF RADIATIVELY COOLED REACTORS FOR SPACE APPLICATIONS, 2 TO 40 MWt. Parks, G. U.; Banach, H. J.; Zeisser, M. H. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). Sep 1965. Contract AT(30-1)-2789. 98p. Dep. NTIS $8.00.

Declassified 31 Aug 1973.

The characteristics and limiting power levels of radiatively-cooled reflector controlled reactors were determined. The power levels studied ranged from 2 to 40 MW(t). Reactors of higher power in this range can become limited by the lack of sufficient control in the moveable reflectors. For this reason, those reactor features having a strong bearing on the control problem were emphasized in the study. Principal geometrical variables were core diameter, core length to diameter ratio (L/D) and side reflector thickness. Reflector thickness was limited by temperature restrictions. In order to lessen the reactivity control requirements of the reflector, the use of an axial center hole in the core was included. An ejectable safety rod in this hole is used to provide part of the shutdown margin and safety in handling. The other major factor which influences reactor design is the fuel system including uranium density, maximum burnup and clad strength. The following fuels have received particular attention: 60 UC–40W; 60 UO_2–40W; 0.80ρ UC (density is 80% of theoretical); and 0.95 ρ UC. 21 references. (auth)

31319 (PWAC-457) 35 AND 300 kW(e) SNAP-50/SPUR POWERPLANTS FOR THE MANNED ORBITING SPACE STATION APPLICATION. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 26 Mar 1965. Contract AT(30-1)-2789. 82p. Dep. NTIS $6.25.

Declassified 6 Sep 1973.

The characteristics of the SNAP-50/SPUR power plant adapted to a typical large orbiting manned space station are described. Power plants of both 35 and 300 kW net electrical output were considered. The 35 kW(e) system was selected as being representative of the minimum power level at which it appears that nuclear reactor power plants are clearly competitive with non-nuclear systems. The larger power level was selected to determine the characteristics of the 300 kW(e) SNAP-50/SPUR reference power plant when adapted to this application. In modifying the basic SNAP-50/SPUR power plant concept for manned applications, it was necessary to provide power conversion system redundancy and increased meteoroid protection in the heat rejection systems. To limit radiation in the space station to suitable levels for crew occupancy, the reactor system and all components containing highly radioactive fluids are located within the shield envelope. Furthermore, the lifetime goal of the space station (5 years) exceeds the design lifetime of the power plant (10,000 hours = 1.2 years); therefore, a design to facilitate power plant removal and replacement was incorporated. Since the shield weight is such a large portion of the over-all weight, a concept was evolved in which about 75 percent of the shield remains permanently attached to the space station and the remaining 25 percent is removable and replaced with the power plant. (auth)

31320 (PWAC-471) REACTOR AND SHIELD DESIGN STATUS—SNAP-50. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). Sep 1965. Contract AT(30-1)-2789. 156p. Dep. NTIS $11.00.

Declassified 20 Sep 1973.

The status of the PWAR-20 design including the reactor test program planned to demonstrate performance and operational capability at termination of the SNAP-50 work at CANEL on June 30, 1965 is reviewed. The reactor and shield component development status is described. (24 references) (auth)

31321 (PWAC-487) SNAP-50 CRITICAL EXPERIMENTS AND ANALYSIS. Callen, R. C.; Check, P. S.; Kearney, R. E.; Welsh, W. F. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). Sep 1965. Contract AT(30-1)-2789. 126p. Dep. NTIS $9.50.

Declassified 12 Sep 1973.

The CCA-7 series of CANEL SNAP-50 critical experiments were undertaken to provide reactor physics data to substantiate the nuclear design analysis of compact, high-temperature reactors for space application. The CCA-7 series included both parametric studies and investigations of specific SNAP-50 design features. The purpose of the parametric studies was to obtain data on the trends in the variations of critical mass, reactivity coefficients, fission rate distributions and effectiveness of methods of reactivity control with variations in core size, core shell thickness, side reflector thickness and material composition. Emphasis was on simplicity of critical assembly configurations in order that the results would be most easily interpreted through analyses with multigroup transport theory digital computer codes. A detailed investigation was made of the effectiveness of reactivity control in the UC-fueled Reference 4 SNAP-50 design by rotation of side reflector segments. Plans for future experiments had included a study of the UN-fueled Reference 5 reactor. (auth)

31322 (PWAC-496) PRELIMINARY DESIGN STUDY OF A 10 MWe NUCLEAR SPACE POWERPLANT FOR ELECTRIC PROPULSION. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). Aug 1965. Contract AT(30-1)-2789. 46p. Dep. NTIS $5.50.

Declassified 6 Sep 1973.

A 10 MW(e) powerplant for a manned Mars mission is investigated. The powerplant packages are to be launched into a 200 to 300 mile orbit, where final assembly of the powerplant and rendezvous with a nuclear rocket engine will be effected. Acceleration out of the earth's gravitational field will be accomplished by the nuclear rocket. Ion engines which require most of the 10 MW(e) generated in the powerplant will be used to complete the manned Mars mission. Major emphasis was placed on the design of the reactor and shield package since this was different from the unmanned 300 kW(e) SNAP-50/SPUR powerplant, and, in addition, represents a major portion of the total powerplant weight. Remaining powerplant components were defined on the basis of parametric studies and scaling of the 300 kW(e) components. System conditions were selected on the basis of judgment considering past experience with other space power system studies. During the course of the study many potential improvements were noted which could not be incorporated into the results. (auth)

31323 (PWAC-554) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT NO. 18, OCTOBER 1, 1955–DECEMBER 31, 1955. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). 1955. Contract AT(11-1)-229. 108p. Dep. NTIS $7.50.

Declassified 20 Sep 1973.

Information on the development of a nuclear powered turbojet engine is presented concerning powerplant performance, propulsion machinery heat exchangers, pump systems, piping systems, reactor engineering and physics, dynamics and control, and materials development. (DCC)

31324 (PWAC-573) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT NO. 25, JULY 1, 1957–OCTOBER 15, 1957. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1957. Contract AT(11-1)-229. 121p. Dep. NTIS $8.25.

Declassified 20 Sep 1973.

Information on the development of sodium and lithium cooled nuclear reactors for turbojet engines is presented concerning powerplant performance and operation, propulsion machinery development, reactor engineering, reactor physics, controls and instrumentation, and materials fabrication and metallurgy. (DCC)

31325 (PWAC-574) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, OCTOBER 1, 1957–DECEMBER 31, 1957. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1957. Contract AT(11-1)-229. 156p. Dep. NTIS $10.00.

Declassified 12 Sep 1973.

Information on the development of lithium and sodium cooled nuclear reactors for turbojet engines is presented concerning reactor engineering, radiator development, lithium corrosion, fuel elements, controls and instrumentation, electronics, and materials development. (DCC)

31326 (PWAC-581) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, JANUARY 1, 1958–MARCH 31, 1958. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 28 Apr 1958. Contract AT(11-1)-229. 154p. Dep. NTIS $9.75.

Declassified 12 Sep 1973.

Information on the development of lithium cooled nuclear reactors for turbojet engines is presented concerning radiator development, reactor engineering, lithium corrosion testing, fuel elements, controls and instrumentation, electronics, and materials development. (DCC)

31327 (PWAC-582) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, APRIL 1, 1958–JUNE 30, 1958. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Jul 1958. Contract AT(11-1)-229. 153p. Dep. NTIS $9.75.

Declassified 20 Sep 1973.

Information on the development of lithium cooled nuclear reactors for turbojet engines is presented concerning reactor engineering, radiator development, lithium corrosion testing, fuel elements, controls and instrumentation, electronics, and materials development. (DCC)

31328 (PWAC-583) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, JULY 1, 1958–SEPTEMBER 30, 1958. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Oct 1958. Contract AT(11-1)-229. 120p. Dep. NTIS $8.00.

Declassified 12 Sep 1973.

Information on the development of lithium cooled nuclear reactors for turbojet engines is presented concerning reactor engineering, fuel elements, controls and instrumentation, and materials development. (DCC)

31329 (PWAC-591) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, JANUARY 1, 1959–MARCH 31, 1959. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Apr 1959. Contract AT(11-1)-229. 138p. Dep. NTIS $9.00.

Declassified 20 Sep 1973.

Information on the development of lithium cooled nuclear reactors for turbojet engines is presented concerning powerplant performance, radiator development, reactor engineering, lithium corrosion testing, fuel element development, reactor physics, controls and instrumentation, and materials development. (DCC)

31330 (PWAC-592) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, APRIL 1, 1959–JUNE 30, 1959. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Jul 1959. Contract AT(11-1)-229. 114p. Dep. NTIS $7.75.

Declassified 12 Sep 1973.

Information on the development of lithium cooled nuclear reactors for turbojet engines is presented concerning reactor engineering, fuel element development, reactor physics, component development, controls and instrumentation, and materials development. (DCC)

31331 (PWAC-593) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, JULY 1, 1959–SEPTEMBER 30, 1959. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Oct 1959. Contract AT(11-1)-229. 118p. Dep. NTIS $8.00.

Declassified 20 Sep 1973.

Information on the development of lithium cooled nuclear reactors for turbojet engines is presented concerning reactor engineering, fuel element development, reactor physics, controls and instrumentation, and materials development. (DCC)

31332 (PWAC-622) LCRE AND SNAP-50-DR-1 PROGRAMS. Engineering Progress Report, April 1, 1962–June 30, 1962. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Jul 1962. Contract AT(30-1)-2789. 164p. Dep. NTIS $10.25.

Declassified 20 Sep 1973.

Information is presented concerning the LCRE reactor experiment design, reactor development, shield development, primary system development, secondary system development, materials development, fuel materials irradiation, operation evaluation, and SNAP-50-DR-1 reactor design and fuel testing. (DCC)

31333 (PWAC-623) LCRE AND SNAP 50-DR-1 PROGRAMS. Engineering Progress Report, July 1, 1962–September 30, 1962.

(Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Oct 1962. Contract AT(30-1)-2789. 158p. Dep. NTIS $10.00.

Declassified 6 Sep 1973.

Information is presented concerning LCRE experiment design, primary coolant circuit, secondary coolant circuit, materials development, and fuel irradiation; and SNAP-50-DR-1 specifications, primary coolant circuit, fuel testing, and materials development. (DCC)

31334 (PWAC-624) LCRE AND SNAP 50-DR-1 PROGRAMS. Engineering Progress Report, October 1, 1962–December 31, 1962. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 20 Mar 1963. Contract AT(30-1)-2789. 125p. Dep. NTIS $8.25.

Declassified 5 Sep 1973.

Information is presented concerning LCRE specifications, reactor kinetics, fuel elements, primary coolant circuit, secondary coolant circuit, materials development, and fabrication; and SNAP-50-DR-1 specifications, primary pump, and materials development. (DCC)

31335 (PWAC-631) LCRE AND SNAP 50-DR-1 PROGRAMS. Engineering Progress Report, January 1, 1963–March 31, 1963. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 10 Jun 1963. 135p. Dep. NTIS $8.75.

Declassified 5 Sep 1973.

Information is presented concerning LCRE specifications, primary coolant circuit, auxiliary systems, fuel elements, instrumentation, materials development, and fabrication; and SNAP-50-DR-1 specifications, fuel elements, pumps, steam generator, and materials development. (DCC)

31336 (PWAC-632) LCRE AND SNAP 50-DR-1 PROGRAMS. Engineering and Progress Report, April 1, 1963–June 30, 1963. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 26 Aug 1963. Contract AT(30-1)-2789. 172p. Dep. NTIS $10.75.

Declassified 6 Sep 1973.

Information is presented concerning the LCRE kinetics, auxiliary systems, fuel, primary cooling system components, instrumentation, secondary cooling system, materials development, and fabrication; and SNAP-50/SPUR kinetics, fuel, primary system pump, steam generator, and materials development. (DCC)

31337 (PWAC-633) LCRE AND SNAP 50-DR-1 PROGRAMS. Engineering Progress Report, July 1, 1963–September 30, 1963. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 25 Nov 1963. Contract AT(30-1)-2789. 146p. Dep. NTIS $10.50.

Declassified 6 Sep 1973.

Information is presented concerning LCRE fuel, components, primary and reflector system, instrumentation, reactor materials; and SNAP-50/SPUR specifications, shielding, pumps, steam generators, and materials. (DCC)

31338 (TIM-864) PWAR-20 REACTOR (2-Mwt) PRELIMINARY NUCLEAR ANALYSIS. Alwang, W. G.; Johnson, H.; Paradis, E. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1 Dec 1964. Contract AT(30-1)-2789. 89p. Dep. NTIS $7.50.

Declassified 30 Aug 1973.

Information on the SNAP-50 Reference 4 Model 1 is presented concerning nuclear analysis and critical experiments. (DCC)

31339 (WANL-TNR-137) NRX-A BLOCK I MECHANICAL DESIGN. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1963. 200p. Dep. NTIS $13.00.

Declassified 30 Aug 1973.

Information on the NRX-A Block I is presented concerning basic configuration and operational criteria, interface areas, NRX-A shield unit, flow screen, outer reflector, and core assembly. 21 references. (DCC)

31340 (XDC-56-10-25) SYSTEMS ANALYSIS AND ECONOMIC OPTIMIZATION OF NUCLEAR ROCKET POWER PLANTS. Hartman, J. L. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). 30 Sep 1956. 71p. Dep. NTIS $5.75.

Declassified 20 Sep 1973.

A systems analysis of specific nuclear rocket propulsion systems is presented. The systems considered are based on heating hydrogen in a graphite reactor for use in a single stage nuclear rocket. Results of a preliminary feasibility study of nuclear rocket propulsion systems which utilize hydrogen as the working fluid and which are capable of accelerating payloads of 0 to 90,000 pounds to burnout velocities of approximately 23,500 feet per second are presented. Economic analyses of various nuclear propulsion systems capable of accelerating given size payloads to a burnout velocity of about 23,500 feet per second were made and the results were used to determine the nuclear rocket propulsion system which would have the lowest production cost for a given size of payload. Preliminary comparisons between chemical and nuclear rocket propulsion systems were made for specific applications which included the intercontinental ballistic missile and "ROBO" Project weapons systems. The results of these studies revealed that nuclear rocket propulsion systems have definite potential for the propulsion of advanced ballistic vehicles requiring large payloads and near-satellite velocities. 4 references. (auth)

31341 NUCLEAR SHIP PROPULSION. Conference Held at Trieste, Italy, June 28, 1973. Com. Naz. Energ. Nucl., Notiz.; 19: No. 11, 35-88(Nov 1973). (In Italian).

Separate abstracts were prepared for each of the eight papers included. (JWR)

For abstracts of individual papers see: 31342–31349.

31342 AMERICAN PROGRAM FOR THE DEVELOPMENT OF MERCHANT VESSELS WITH NUCLEAR PROPULSION. Pitkin, M. Com. Naz. Energ. Nucl., Notiz.; 19: No. 11, 38-41(Nov 1973). (In Italian).

From conference on day of nuclear ship propulsion; Trieste, Italy (28 Jun 1973).

The program, initiated three years ago, for the development of nuclearly propelled merchant vessels is briefly outlined. The results achieved are briefly examined. The future of merchant vessels with nuclear propulsion is discussed on the basis of an evaluation of what can be realistically assumed. (JSR)

31343 ACTIVITY OF WEST GERMANY IN THE FIELD OF NUCLEAR NAVAL PROPULSION. Schroeder, E. (GKSS, Geesthecht, Ger.). Com. Naz. Energ. Nucl., Notiz.; 19: No. 11, 42-49 (Nov 1973). (In Italian).

From conference on day of nuclear ship propulsion; Trieste, Italy (28 Jun 1973).

The technological developments in the construction of ships are outlined and the advantages of nuclear propulsion are cited. The present situation with respect to the development and operation of reactors mounted on ships is outlined. The safety and economy of nuclear vessels is considered. In conclusion the West German program for the development of a nuclear merchant vessel is given. (JSR)

31344 CONSTRUCTION AND SAFETY PROBLEMS OF PROPULSION SYSTEMS STUDIES IN FRANCE. Baujat, J. (CEN, Saclay, France). Com. Naz. Energ. Nucl., Notiz.; 19: No. 11, 50-51(Nov 1973). (In Italian).

From conference on day of nuclear ship propulsion; Trieste, Italy (28 Jun 1973).

The construction problems caused by the use of a nuclear propulsion system are briefly outlined. The problems of safety are discussed in order to show that the level of safety in nuclear vessels is superior to that of conventional ships. (JSR)

31345 NUCLEAR PROPULSION FOR MERCHANT SHIPS IN THE CEE. Boos, I. H. Com. Naz. Energ. Nucl., Notiz.; 19: No. 11, 52-55(Nov 1973). (In Italian).

From conference on day of nuclear ship propulsion; Trieste, Italy (28 Jun 1973).

The high investment costs and the difficulties encountered by the "Savannah" and "Otto Hahn" in obtaining permission to enter ports have deterred ship owners from the construction of nuclear vessels. The present maritime politics are considered as they relate to nuclear vessels. A possible European solution to encourage the construction of nuclear vessels, based on direct government participation in the construction costs or government funding of the cost difference between nuclear and conventional ships and government compensation in the event of loss, is outlined. (JSR)

31346 NUCLEAR NAVAL PROPULSION DEVELOPED IN ITALY. Part I. Franco, G.; Cavaggioni, M. Com. Naz. Energ. Nucl., Notiz.; 19: No. 11, 58-67(Nov 1973). (In Italian).

From conference on day of nuclear ship propulsion; Trieste, Italy (28 Jun 1973).

The characteristics of the PWR reactor developed for the "Enrico Fermi" are outlined. The research and development studies made on fuel elements and the components of the nuclear plant are briefly described. (JSR)

31347 NUCLEAR NAVAL PROPULSION DEVELOPED IN ITALY. Part II. Cesoni, G.; Chinaglia, L. Com. Naz. Energ. Nucl., Notiz.; 19: No. 11, 68-77(Nov 1973). (In Italian).

From conference on day of nuclear ship propulsion; Trieste, Italy (28 Jun 1973).

The modifications made to the FDR reactor with the installation of the second core are outlined. These modifications consist in the use of Zircaloy for both the tubes containing the fuel tablets and for the structural part of the fuel element. Bunch-type control elements are substituted for the cruciform control rods. (JSR)

31348 NUCLEAR NAVAL PROPULSION DEVELOPED IN ITALY. Part III. Jannoulis, P. Com. Naz. Energ. Nucl., Notiz.; 19: No. 11, 78-82(Nov 1973). (In Italian).

From conference on day of nuclear ship propulsion; Trieste, Italy (28 Jun 1973).

Tests simulating a collision between two tankers were carried out to determine the probable damage and to evaluate the efficiency of an anticollision barrier. The test conditions were described in some detail, and the results are reported. (JSR)

31349 TECHNICAL PROBLEMS CONNECTED WITH THE INSTALLATION OF NUCLEAR PLANTS ON BOARD SHIPS. de Grenet, F. Com. Naz. Energ. Nucl., Notiz.; 19: No. 11, 83-88 (Nov 1973). (In Italian).

From conference on day of nuclear ship propulsion; Trieste, Italy (28 Jun 1973).

The principal uncertainties connected with nuclear propulsion are outlined. Problems connected with the construction costs, safety, and the containment vessel are briefly cited. The characteristics of the four nuclear ship constructed are described. Recent technical developments made on containment vessels, the secondary circuit, flooding valve, and the anticollision barrier are discussed. (JSR)

Reactor Safety and Environmental Aspects

Refer also to abstracts 29180, 29202, 29294, 29297, 29305, 29306, 29311, 29318, 29346, 29354, 29356, 29357, 29360, 29362, 29383, 29384, 29768, 29776, 29778, 31155–31157, 31221, 31234, 31235, 31312, and 31593.

31350 (ANCR-1146) EXPERIMENT DATA REPORT FOR 1½-LOOP SEMISCALE SYSTEM ISOTHERMAL TEST 1011. Alder, R. S.; Feldman, E. M.; Pinson, P. A. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Mar 1974. Contract AT(10-1)-1375. 50p. Dep. NTIS $5.45.

Recorded test data are presented for Test 1011 of the isothermal portion of the Semiscale Blowdown and Emergency Core Cooling (ECC) Project. The data represent the results of a test in the isothermal test series in which a break nozzle area 80% that of other test configurations was used with no simulated ECC injection. The data, presented in the form of graphs in engineering units, have been analyzed only to the extent necessary to assure that they are reasonable and correct. Uninterpreted data from Test 1011 for use by others and for support of subsequent interpretive reports and analyses are presented. (auth)

31351 (BAW-10081) CALCULATION OF MAXIMUM FUEL ENTHALPY DURING ROD EJECTION ACCIDENT. Scott, J. F. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Feb 1974. 9p.

Two methods of calculating maximum fuel enthalpy during a rod ejection accident are set forth. Examination of the relative conservatisms of the two methods reveals that the values of fuel enthalpy are well below the threshold value for prompt fuel failure regardless of the method used. The methods are applicable to 177-fuel-assembly plants which have operating licenses or are expected to receive operating licenses in 1974. (auth)

31352 (BNWL-1787) TECHNIQUE FOR ENVIRONMENTAL DECISION MAKING USING QUANTIFIED SOCIAL AND AESTHETIC VALUES. Burnham, J. B.; Karr, M. H.; Wilfert, G. L.; Maynard, W. S.; Nealey, S. M.; Jones, G.; Jones, L; Gray, B.; Parker, N.; Coe, J.; Geitner, N. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1974. Contract AT(45-1)-1830. 255p. Dep. NTIS $7.60.

A four-phase study was designed for the evaluation of social, economic and environmental tradeoffs in the analysis of nuclear power plant siting options. The results of the first phase of this work are reported. This phase included: examination of environmental statements and guidelines and intervenors' statements to determine the significant criteria to be analyzed; development of a questionnaire with design options for two chosen sites; the answering of the questionnaire by environmentalists, high school students, and businessmen; analysis of the survey results; and an explanation of the mechanics of making the analysis of a given design on a given site. (LCL)

31353 (COO-2152-6) INVESTIGATION OF PRESSURE DROPS AND HEAT TRANSFER COEFFICIENTS FOR LOSS OF COOLANT EVALUATIONS. Quarterly Progress Report Period Ending December 31, 1972. (Cincinnati Univ., Ohio (USA). Dept. of Chemical and Nuclear Engineering). 1972. Contract AT(11-1)-2152. 6p. Dep. NTIS $4.00.

Progress in experiments on pressure drop and heat transfer phenomena of importance during a loss of coolant accident is reported. The experiments include a transient pressure drop investigation, a two-phase pressure drop and flow pattern study, and transition boiling and reflooding heat transfer tests. (JWR)

31354 (EPA-520-9-73-3-C) ENVIRONMENTAL ANALYSIS OF THE URANIUM FUEL CYCLE. Part II. Nuclear Power Reactors. (Environmental Protection Agency, Washington, D. C. (USA). Office of Radiation Programs). Nov 1973. 169p.

The environmental impact of radiation from enriched uranium light water reactors is analyzed. Topics covered include reactor and site characteristics, sources of radioactive discharges to the environment, discharge control option considerations, liquid discharge control options, noble gas discharge control options, radioiodine discharge control options, determination of population radiation exposure, estimated radiation exposure from nuclear reactor effluents, and economic and environmental costs. (JWR)

31355 (EPA-660-2-73-16) REVIEWING ENVIRONMENTAL IMPACT STATEMENTS: POWER PLANT COOLING SYSTEMS, ENGINEERING ASPECTS. (National Environmental Research Center, Corvallis, Oreg. (USA)). Oct 1973. 93p. GPO $1.35.

The approach and technical base that have been used by EPA's National Thermal Pollution Research Program for reviewing those portions of Environmental Impact Statements (EIS's) relative to the engineering aspects (including economics) of cooling water systems for thermal power plants are presented. Techniques and data are provided to enable the EIS reviewer to make sound judgments concerning the adequacy of both the cooling water system selected for the power plant and the EIS comments on that system. Literature citations are provided to direct the reviewer to additional and more detailed information. Information and discussions on cooling system configurations, operation, environmental effects, and costs are included. Consideration is given to the intake as well as the discharge. Various closed-cycle cooling systems employing cooling towers, cooling ponds, spray systems, and other devices are covered. Methods of assessing alternative selections and benefit-cost analyses are presented. Non-thermal aspects of cooling water systems are discussed. The groundwork for a technically sound EIS review is presented. 60 references. (auth)

31356 (FPR-2-74) UO_2/SODIUM THERMAL INTERACTION EXPERIMENTS AT A.W.R.E. FOULNESS SINCE JANUARY 1972. Darby, K. I.; Pottinger, R. C.; Turner, R. G.; Rees, N. J. M. (UKAEA Weapons Group, Foulness. Atomic Weapons Research Establishment). Jan 1974. 26p. (CONF-731126-3; TRG-Memo-6416; CFR-SWP/P-(74)2). Dep. NTIS (U. S. Sales Only) $3.50.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra–Varese, Italy (21 Nov 1973).

Work has continued to refine the experimental techniques. The unwanted gas content of the pyrotechnic charge has been identified as absorbed water vapor and a dry glove box assembly system is being constructed to remove it from the pyrotechnic charges. Some bomb calorimeter firings of both burst and unburst charges have confirmed the total theoretical energy release, and recent chemical analyses of the debris recovered from sodium (by chemical extraction with alcohol) showed the pyrotechnic reaction had substantially burnt to completion. Experiments to correlate rate of charge burning with the pressure rise in the charge container are proceeding using a transparent quartz charge holder and photography together with attempted thermocouple measurements. Charges with UO_2 diluent have been fired under sodium and water producing effects identical to previously reported experiments using Al_2O_3 diluent. Steps are currently being taken to separate debris from sodium by the purely physical process of distillation. Pyrotechnic charges diluted with finely divided aluminium metal and separately with silver have been fired under water in a viewing vessel to see if a metal/water thermal interaction could be demonstrated in this rig. This new vessel retains the original internal cylindrical geometry with optical correction on the viewing window for the cylindrical lens effect. These experiments produced very much higher gas blanket pressures on the first bubble expansion but this is thought to be a vapour pressure effect from the charge. The main debris engulfment is seen to take place shortly after the first peak gas blanket pressure and there is some evidence of a variation in the gas blanket pressure decay at this point in time. This may be evidence of a thermal interaction. One frictional plate has been constructed and used (50% void area) with a negligible effect

on measured gas blanket pressures. The plate was supported from the lid on 3 piers and the load on them measured with strain gauges. Some firings with increased initial static gas blanket pressures have been performed as a means of limiting the first bubble excursion. (auth)

31357 (NIIAR-P-196) ECONOMY CONSIDERATIONS IN THE ANALYSIS OF LARGE FAST REACTOR SAFETY. Nikol'skii, R. V. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Melekess (USSR)). 1973. 18p. (In Russian). INIS.

Some characteristics of the safety control of a nuclear power plant with a large fast reactor were discussed. The necessity and possibility of considering economic requirement during the probability approach to safety problems was noted. An analysis was made of the properties of fast reactors with respect to the self-limiting dimensions of the hypothetical accident which can be initiated by the introduction of positive reactivity. The relation of the sodium effect and the Doppler effect was examined particularly. This analysis was illustrated by the calculation results. (tr-auth)

31358 (NP-19938, pp vp, Paper 4) RELEASE OF FISSION PRODUCTS IN EXTREME INCIDENTS IN NUCLEAR REACTORS. Jacobi, W.; Stolterfoht, N. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nov 1971. (In German).

Evaluation of the release of fission products from a reactor in the event of a catastrophic accident is limited to the consideration of pressurized and boiling water reactors, damaged as a result of sabotage or war. The maximum credible accident for these reactor types is described. The fission product activity accumulated in the fuel elements is evaluated. The activity of individual nuclides is calculated. The release of the fission products from the fuel elements to the containment vessel is then considered, and the time variation of the activity in the containment vessel after the accident is calculated. The release rate from the containment vessel to the atmosphere and the activity released are evaluated. (JSR)

31359 (ORNL-NSIC-100) NUCLEAR POWER AND RADIATION IN PERSPECTIVE. Selections from Nuclear Safety. Buchanan, J. R. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 182p. Dep. NTIS $15.00.

The risks of nuclear power and radiation are described to place them in perspective with other potential hazards faced by the public on a day-to-day basis in our complex industrial society. Twenty articles on this general topic that have appeared in Nuclear Safety are reprinted, since they collectively form a valuable reference source. Topics covered include the effects of radiation, risk-benefit concepts, radiation risks relative to other risks, nuclear plant risks relative to fossil plant risks, licensing requirements, nuclear insurance, nuclear industry safety record, and public attitudes. (auth)

31360 (UCRL-51507) SEISMIC ANALYSIS LIVERMORE POOL TYPE REACTOR FACILITY, LAWRENCE LIVERMORE LABORATORY. Murray, R. C.; Tokarz, F. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Nov 1973. Contract W-7405-eng-48. 34p. Dep. NTIS $4.00.

A seismic evaluation of the Livermore Pool Type Reactor Facility located at the Lawrence Livermore Laboratory was conducted as part of a safety analysis being prepared for the Atomic Energy Commission. The safe shutdown earthquake for the Lawrence Livermore Laboratory site is defined, along with a brief discussion of its basis. The method of analysis and results are summarized for all critical components. It is concluded that the biological shield and containment building should withstand the safe shutdown earthquake without failures. The crane and heat exchanger could fail under worst-case loading conditions. Recommendations for modifying the crane and heat exchanger support are presented. (auth)

31361 PROBLEMS OF A REVISION OF THE PARIS LIABILITY CONVENTION. Lagorce, M. M. (1973). vp.

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

A review of the content of the Paris Liabilities Convention revealed that revisions must be made in order to be in harmony with the Vienna convention. Articles cited for review are discussed. (MCW)

31362 PROBLEMS OF OCCUPATIONALLY INVOLVED RADIATION INJURIES WITH SPECIAL REGARD TO FRENCH LEGISLATION. Hebert, J. (1973). vp.

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

In French law there are two systems of establishing causality liability in occupationally involved radiation injuries. These systems are compared and their effect on each other discussed. (JSR)

31363 EURATOM-IAEA AGREEMENT ON THE APPLICATION OF THE NON-PROLIFERATION TREATY. Gijssels, J. (1973). vp.

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The compatibility of the general objectives of the Non-Proliferation Treaty and EURATOM is established. The major problem to be resolved is to safeguard the EURATOM Treaty while allowing the IAEA to assume its responsibilities toward the signatories of the Non-Proliferation Treaty and more generally toward international organizations. Inspection and domestic safeguards are significant facets of this problem. (JSR)

31364 EXCLUSION ON LIABILITY FOR DAMAGES OF THE NUCLEAR INSTALLATION AND OF GOODS AT THE SITE OF THE INSTALLATION. Suontausta, T. (1973). vp. (In French).

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

A critical examination was made of article 3a ii of the Paris Liabilities Convention. It is found that the convention itself establishes a satisfactory base for national legislation dealing with the exclusion on liability for damages to the nuclear installation and goods at the site. (MCW)

31365 DISCUSSION OF OPEN QUESTIONS IN LICENSING PROCEDURE OF NUCLEAR POWER PLANTS SITED AT NATIONAL FRONTIERS, WITH SPECIAL REFERENCE TO INTERNATIONAL LAW. Moser, B. (1973). vp.

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

Nuclear power plants sited at national frontiers give rise to a number of new legal problems, especially in those cases where the border line is determined by a river whose waters will be used in the operation of that plant. Loyalty and good faith are the basic principles of the international law. A country should abstain from any measures adversely affecting a neighboring country. It is concluded that current national licensing procedures are inadequate. It is shown that a neighboring country can be more affected by a nuclear power plant than the country where the plant is actually located, and it is suggested that appropriate legal provisions be set up that will allow neighboring countries to participate in the licensing procedures. (GE)

31366 LAW OF CAUSALITY IN AUSTRIAN NUCLEAR LIABILITY REGULATIONS, WITH SPECIAL REFERENCE TO PROVISIONS OF THE SOCIAL INSURANCE INSTITUTIONS. Moser, B. (1973). vp. (In German).

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

Referring to the difficulties encountered in establishing a causality between the emission of ionizing radiation, which cannot be detected by sensory perception, and the occurrence of an actual damage, the ruling doctrine of an adequate relation of cause and effect and the conclusion that this doctrine is completely inadequate are discussed. It is suggested that the requirements for giving evidence of the causality be reduced and a three-stage theory is presented. The extended assumption of causality for nuclear events as included in the Austrian nuclear liability regulation of April 29, 1964 and the lack of appropriate special provisions in the social insurance scheme are discussed. (GE)

31367 ATTITUDE OF FRENCH INSURERS CONCERNING THE CAUSALITY PRINCIPLE. Deprimoz, J. (Pool Francais d'Assurances des Risques Atomiques, Paris). (1973). vp.

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

Details are made known that clarify the position of the insurors. Medical aspects are discussed rather than legal aspects and include radiation damage to persons and properties. Note is made of psychological and genetic injuries and possible damage of an economic nature. (MCW)

31368 NUCLEAR SHIPS IN THE MARITIME LAW OF YUGOSLAVIA. Filipovic, V. (Zagret Univ., Yugoslavia). (1973). vp.

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The safety regulations of the SOLAS agreement and the regulations of international law are applied to nuclear ships under foreign colors obtaining permission to enter a harbor after examination of the safety report. The problems of distressed nuclear ships at sea are discussed. The completely insufficient liability of shipping companies according to the French Code de Commerce (1807) will be substituted by a sea and inland navigation law. For the first time, liability regulations will be provided for in compliance with the principles of the Brussels Convention on the Liability of Operators of Nuclear Ships (1962). (GE)

31369 RELEASE OF UNSTABLE FISSION PRODUCTS DURING VARIABLE REACTOR OPERATING HISTORIES. Turnbull, J. A.; Tucker, M. O. (Central Electric Generating Board, Berkeley, Eng.). J. Nucl. Mater.; 50: No. 1, 47-52(Feb 1974).

A solution to the diffusion equation describing the release of unstable fission products during irradiation was obtained which may be employed for consecutive periods at different temperatures and ratings. The equations were used to evaluate the release of species of different half-lives for three idealized irradiation histories which retain the same time-averaged irradiation conditions. Results illustrate the wide spectrum of release characteristics displayed by short-, medium-, and long-lived species for these cases. It is concluded that the employment of the present analysis is essential for an accurate assessment of radiological hazard. (auth)

31370 NUCLEAR POWER PLANTS AND THE ENVIRONMENT. Salvetti, C. Com. Naz. Energ. Nucl., Notiz.; 19: No. 12, 52-63(Dec 1973). (In Italian).

From fifth Foratom congress; Florence, Italy (15 Oct 1973).

The characteristics of the Foratom countries are briefly outlined. The impact of nuclear power plants on the environment is considered in some detail. The opposition to nuclear power plants by environmentalists is discussed. (JSR)

31371 PERSONNEL RADIATION EXPOSURE ASPECTS OF OPERATION, MAINTENANCE, AND REFUELING A BOILING WATER REACTOR. Sinderman, R. W.; Axtell, C. E. (Consumers Power Co., Jackson, MI). pp 109-124 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The Big Rock Point Nuclear Plant is described and dose distributions are discussed with regard to occupational group, plant history, and specific maintenance items. A table is presented to show rem gamma, average rem per man, and % of total rem for operators, outside maintenance personnel, plant maintenance personnel, technicians, and supervisory personnel. The plant maintenance crew received an average of 26 rem each over their 6-yr plant exposure history. Dose distribution with respect to off-gas activity is discussed. The data show that exposures to radiation have been high. The greatest single cause of exposure to ionizing radiation was a result of fuel failures. Exposures can be reduced substantially by proper equipment design including the ease of maintenance as well as proper location of the equipment. (HLW)

31372 OPERATIONAL EXPERIENCE IN RADIOLOGICAL CONTROL DURING THE N. S. SAVANNAH FUEL SHUFFLE. Logsdon, J. E.; Terpilak, M. S.; Kincaid, C. B.; Gaeta, N. A. (Bureau of Radiological Health, Rockville, MD). pp 285-310 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

The role of the public health service in providing radiological consultation and assistance to the Maritime Administration concerning operation of the ship is discussed. Other topics discussed are: preparations for the fuel shuffle including a safety analysis report for the AEC; health physics controls during fuel shuffle operations; maintenance facilities; health physics functions; contamination control; radiation exposure control; and waste disposal. Recommendations for radiation control are discussed and include the use of a computerized radiation work permit. (HLW)

31373 RADIOGAS MONITORING AND LEAK DETECTION. Liebler, G. H.; Nelson, W. F.; Tamburri, J. (Consolidated Edison Co. of New York, Inc., New York). pp 1079-1091 of Health Physics Operational Monitoring. Vol. 2. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P2.

The existence of pockets of radioactive contamination within enclosed cells at a nuclear facility may remain undetected when full reliance is placed on air monitoring of the ventilating systems. Monitors of these types can detect concentrations of radiogas as low as 10^{-7} μCi/cc in the main branch of the systems but the air from any one room may be diluted 100 to 1000 times, thereby reducing the detectable limit to 10^{-4} to 10^{-5} μCi/cc, above the MPC for xenon-133, the major component of the radiogas in purification and gas handling processes. The utilization of a portable tritium monitor for surveillance of work locations subjected to these unsuspected leakages is described as well as its employment for the location of the leaking components. This instrument lends itself to the measurement of any beta emitting radiogas and its sensitivity increases as a direct ratio of the beta energy with a measurement sensitivity for xenon-133 of 5×10^{-8} microcuries per cubic centimeter. (auth)

31374 FACILITY DECONTAMINATION FOLLOWING A NUCLEAR ROCKET REACTOR TEST. Gallimore, J. C.; Mohrbacher, J. A. (Pan American World Airways, Inc., Jackass Flats, NV). pp 1489-1507 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

During full-power testing of a proto-type nuclear rocket engine in June, 1965, an accidental loss of coolant occurred at shutdown that resulted in ejection of reactor fuel from the engine. Approximately 10^6 curies of fission product activity at one hour after shutdown was deposited over five acres. The area of most severe involvement was approximately one acre and contained fragments of fuel elements, inches in length, and more than five fragments per 100 square feet. Decontamination was initiated 24 days following the accident and was effectively completed 35 days later. A significant portion of the test facility was released prior to this time. General dose rates of 5 to 10 R per hour, at waist level, existed at the beginning of the decontamination effort. To accomplish this decontamination effort, 210 personnel made 453 entries into the facility and accumulated a total radiation exposure of approximately 175 R. In addition to describing the method of decontamination, management difficulties, responsibilities, and health physics relationships concerning this effort are discussed. (auth)

Reactor Theory and Calculation

Refer also to abstracts 30689, 30690, 30776, and 31222.

31375 (BAW-3647-28) PHYSICS VERIFICATION PROGRAM, PART III, TASK 9. Quarterly Technical Report, July–September 1973. Webb, H. W.; Baldwin, M. N. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Research and Development Div.). Feb 1974. Contract AT(11-1)-3109. 16p. Dep. NTIS $4.00.

In experimental Task 9, the fission rate in low-enriched UO_2 fuel pins and the neutron absorption rate in the boron of a simulated lumped burnable poison (LBP) material in a critical assembly are being measured. These rates are being compared for a few select core positions and for two types of LBP pins. (auth)

31376 (CONF-730465-, pp vp. V. 6, Paper 511) MOTION OF A CYLINDRICAL BODY SUSPENDED IN A CIRCULAR FLOW PASSAGE. Rapier, A. C. (United Kingdom Atomic Energy Authority Reactor Group, Sellafield, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

It is sometimes necessary to suspend a body in a flow passage with the possibility of vibration being induced, e.g., a fuel element within a reactor channel. The general problem of the motion of the body and the fluid is too complex for a theoretical analysis. It is shown that approximate analyses of particular cases, based on very simple postulates, can be used to determine the most appropriate dimensionless groups of variables and parameters and the probable form of the functional relationships between them. This method of "fractional analysis" is applied to three sets of experimental data and is shown to have several advantages over simple dimensional analysis. (auth)

31377 (IAE-2241) STUDIES ON THE THERMAL NEUTRON UTILIZATION FACTOR DEPENDENCE ON THE URANIUM–WATER LATTICE PINCH. Aborina, I. N.; Komissarov, L. V.; Lunin, G. L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 12p. (In Russian). INIS.

The results of the measurement of the disadvantage factor of the thermal neutron flux in uranium–water lattices were reported for different water–uranium ratios. The lattice contained the experimental fuel elements VVER (uranium dioxide enriched up to 3.5% in ^{235}U). The size of the utilization factor for thermal neutrons was calculated from the measurement results. The experimental size was compared with the calculated size. This comparison led to the following conclusions. The calculated value of the disadvantage factor of the thermal neutron flux coincides

satisfactorily with experimental results for a well thermalized uranium–water lattice. For a pinched uranium–water lattice with poorly thermalized neutron spectrum the calculated value of the disadvantage factor of the thermal neutron flux is overestimated in comparison with the experimental value. The calculated and experimental values of the utilization factor of thermal neutrons satisfactorily agreed for uranium–water lattices of all spacings used. (tr-auth)

31378 (IAE-2260) NUMERICAL CALCULATION OF THREE-DIMENSIONAL HETEROGENEOUS REACTORS. Rumyantsev, A. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 19p. (In Russian). INIS.

A method was described for the calculation of the neutron-physical characteristics of three-dimensional heterogeneous reactors, each rod of which can have different properties. A system of heterogeneous equations was formulated and an iterative method for their solution was proposed. The proposed method was realized in a complex program written in the Fortran language, which was intended for the calculation of consistent neutron-physical and thermohydraulic characteristics of macrocells of channel power reactors. (tr-auth)

31379 (JPRS-60560, pp 66-78) EXERGETIC ANALYSIS OF N_2O_4 CYCLES. Gokhshtein, D. P.; Tetel'baum, S. D.; Grivanova, S. M. 16 Nov 1973. Translated from pp 75-90 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

An exergetic analysis of a complete thermodynamic cycle of N_2O_4 coolant in a reactor was performed to determine the quantity and distribution of exergetic losses in the system. (JWR)

31380 (JPRS-60560, pp 90-93) CALCULATION OF THE OPTIMAL GEOMETRIC CHARACTERISTICS OF THE CORE OF A REACTOR FOR GIVEN THERMOHYDRAULIC CHARACTERISTICS WHEN N_2O_4 IS USED AS COOLANT. Mirgorodskii, V. S.; Tverkovkin, B. E.; Shinkevich, O. S. 16 Nov 1973. Translated from pp 104-108 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

A procedure is presented for calculating the optimum geometric characteristics of an N_2O_4 cooled reactor for given thermohydraulic characteristics. (JWR)

31381 (JPRS-60560, pp 94-106) INVESTIGATION OF VARIABLE REGIMES OF POWER PLANTS USING DISSOCIATED WORKING SUBSTANCES. Greben'kov, Zh. A.; Gimmel'shtein, Ya. E. 16 Nov 1973. Translated from pp 109-121 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The dynamics of nuclear power plants using dissociating gases as the working substance are discussed. The calculations of power plant variables under different load conditions are examined. Some calculations for nuclear power plants using Al_2Cl_6, Al_2Br_6, and N_2O_4 are reviewed. (JWR)

31382 (JPRS-60560, pp 107-115) VARIABLE CONDITIONS OF SINGLE-LOOP NUCLEAR POWER PLANTS WITH DISSOCIATING COOLANT. Sharovarov, G. A.; Tashilova, A. M. 16 Nov 1973. Translated from pp 122-130 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The calculation of the parameters of a single loop nuclear power plant cooled by a dissociating gas and working under fractional load conditions is discussed. (JWR)

31383 (JPRS-60560, pp 116-127) SPECIAL FEATURES OF NUCLEAR POWER PLANTS WITH DISSOCIATING COOLANT. Sharovarov, G. A. 16 Nov 1973. Translated from pp 131-143 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on disassociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

Special processes taking place in the coolant of nuclear power plants cooled by a dissociating gas are examined. A mathematical model of these unsteady processes is developed. This model is used to obtain a simplified mathematical description for the variable parameters of nuclear power plants cooled by dissociating gas. (JWR)

31384 (JPRS-60560, pp 212-220) DEVELOPMENT OF EXPERIMENTAL STUDIES IN FAST REACTOR PHYSICS AT THE INSTITUTE OF NUCLEAR POWER OF THE BELORUSSIAN ACADEMY OF SCIENCES. Naumov, V. A.; Slizov, V. P.; Churkin, Yu. I.; Yaroshevich, O. I. 16 Nov 1973. Translated from pp 229-234 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The research program at the Institute of Nuclear Power of the Belorussian Academy of Sciences concerned with the development of fast reactors with dissociating gas coolants (N_2O_4 and Al_2Br_6) is summarized. (JWR)

31385 (NIIAR-P-190) STUDY OF SOME PROGRESS APPLICABILITY TO PHYSICAL PARAMETERS CALCULATIONS. Grachev, E. A.; Deinega, N. P. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 21p. (In Russian). INIS.

The results of studies on the selection of programs for the calculation of the physical parameters during complex optimization of large fast reactors were reported. On the basis of the data obtained and the requirements imposed on the calculations at different stages of optimization conclusions were made on the suitability of these programs for optimization calculations. A comparison of the accuracy of the calculations was made for the basic characteristics of large fast reactors. The results obtained can be useful both during the selection of programs for the calculation of the physical parameters for the complex optimization of fast reactors and during the development of improved mathematical algorithms of these calculations. (tr-auth)

31386 (NP-19972) INTERPRETATION OF NEUTRON AND GAMMA NOISE MEASUREMENTS BASED ON A STOCHASTIC TWO-GROUP MODEL. Baers, B. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Reaktorilaboratorio). Nov 1972. 18p. Dep. NTIS (U.S. Sales Only) $4.00.

Based on a previously developed stochastic two-group model, all correlation functions associated with the detection of fast neutrons, thermal neutrons and photons are of the form $A + B_1 \exp(-\alpha_1\tau) + B_2 \exp(-\alpha_2\tau)$. The subindex 1 is associated with the fast-neutron-group relaxations and subindex 2 with the lowest eigenvalue when delayed neutron and photon emissions are regarded as completely random. A parameter estimation procedure is outlined based on the utilization of the relaxation constants α_1 and α_2 and the eighteen relative correlation amplitudes B_1/A and B_2/A in a 3×6 correlation matrix. The two-group model is applied to noise measurements previously obtained with an in-core thermal neutron detector and an in-core and an ex-core photon detector. The nine relative correlation amplitudes B_2/A in the 3×3 correlation matrix obtained are used to estimate nine basic reactor parameters including four coupling ratios, three sources of correlated fluctuations and two neutron-to-gamma conversion factors. The results verify that more information of the process can be obtained from gamma and thermal neutron noise measurements than from pure thermal neutron noise measurements. (auth)

31387 (RT/FI-(73)40) NUCLEAR NOISE: TWO GENERALIZED POISSON DISTRIBUTIONS. Pacilio, N.; Jorio, V. M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 23 Oct 1973. 66p. (In Italian). Dep. NTIS (U. S. Sales Only) $6.50.

In search of a new probability distribution function approximating the Pal-Mogilner-Zolotukhin-Bell-Babala profile, four generating functions are introduced, analyzed and mutually compared. They lead to: (1) the Logarithmic distribution, (2) the Radical distribution, (3) the Poisson-Logarithmic distribution and (4) the Poisson-Radical distribution. Distribution (3) is also known as Pascal or Polya or Negative Binomial distribution. Distributions (2) and (4) are an absolute novelty in the field of probability theory and applications. Distributions (3) and (4) belong to the class of "generalized Poisson distributions." (auth)

31388 (WARD-XS-3045-5) PHYSICS EVALUATIONS AND APPLICATIONS. Quarterly Progress Report for Period Ending January 31, 1974. Paik, N. C.; Durston, C.; Davis, W.; Yarbrough, M. B. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Mar 1974. Contract AT(11-1)-3045. 30p. AT.

The overall coordination efforts on the ENDF/B-IV ^{238}U data evaluation, the CSEWG committees, and the Big 3 task force continued. The ENDF/B-IV ^{238}U data file in its present form has been corrected for recommendations that were specified during the December CSEWG meeting. The preliminary tape of the ^{238}U ENDF/B-IV neutron data has been modified by LASL to include pseudo-level presentation of continuum inelastic scattering. The initial version of SPHINX code which was sent to LASL has been successfully executed on their CDC-6600 and CDC-7600 computers. Work is continuing to complete the increased scattering matrix treatment in the SPHINX code. Work has been initiated to make the standard interface version of the one dimensional transport code ANISN operational on the CDC-7600 at ARD. The code, which was received from LASL, was successfully compiled on the CDC-7600. ARD file manager routines and associated routines have been inserted into the code. The cell homogenization routine is being made compatible with the standard interfaces so that the routine can be inserted into the standard interface version of ANISN. (auth)

31389 VARIATIONAL METHODS IN NUCLEAR REACTOR PHYSICS. Stacey, W. M. Jr. Nuclear Science and Technology. Volume 10. New York; Academic Press Inc. (1974). 189p.

Chapters are included on variational estimates and perturbation theory, applications of variational estimates and generalized perturbation theory, variational formulations, synthesis, and variational theory. Extensive references are provided. (JWR)

Reactor Components and Accessories

Refer also to abstract 31222.

31390 (AED-Conf-73-463-001) DEVELOPMENT CONCEPTS OF PRIMARY COOLANT RECIRCULATING PUMPS FOR NUCLEAR POWER PLANTS. Gaffal, K. 1973. 13p. (In German). INIS.

From pump conference; Karlsruhe, Germany (2 Oct 1973).

The layout and design of primary coolant recirculating pumps is closely connected with the development of the various types of reactors. Reactor safety aspects have an influence on the conception of reactors as well as on the design features of pressure retaining pump components. The rapid increase in pump capacities has affected the mechanical hydrodynamical layout of recirculating pumps. (INIS)

31391 (CONF-730465-, pp vp. V. 2, Paper 218) LOCAL AND LONG-RANGE PRESSURE FLUCTUATIONS INDUCED BY A FLUID FLOW IN A SUDDEN ENLARGEMENT. Gibert, R. J.; Livolant, M. (CEN de Saclay, Gif-sur-Yvette, France). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Random fluid pressure fluctuations at the walls of reactor coolant circuits can excite certain mechanical resonances leading to bursts. Unsteadiness can arise at singular points of the circuit and can be transmitted acoustically to the whole circuit. A study is presented of a simple case where the specific part of the circuit considered is a sudden enlargement. A description is given of the experiment, and the measurements, made by a dynamic pressure transducer, are analyzed. A study is made of local phenomena (direct effects of the unsteadiness downstream from the enlargement) and also of long-range or acoustical phenomena. The acoustical propagation in the circuit is calculated using the code VIBRAPHONE. In addition to providing information for the specific case the work was aimed at establishing a method of research and of demonstrating typical parameters which will be useful in studying other cases. (UK)

31392 (CONF-730465-, pp vp. V. 6, Paper 613) STUDY ON ULTIMATE STRENGTH OF PIPING VIBRATION ON NUCLEAR POWER PLANT FACILITIES. Shiraki, K.; Fujita, K. (Mitsubishi Heavy Industries Ltd., Kobe, Japan). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Vibration experiments were performed on piping models of nuclear power plant facilities. As their natural frequencies were obtained in the form of mechanical impedance curves, they were compared with a numerical solution using the Laplace transformation. Simultaneously, the calculation of eigenvalue was carried out. Experimental values of seismic response were compared with some calculated by modal analysis methods. The strength margin of the piping was estimated. (UK)

31393 (CONF-730465-, pp vp. V. 6, Paper 627) VIBRATION INSTRUMENTATION FOR NUCLEAR REACTORS. Thomas, R. L. (Endevco Corp., Pasadena, CA). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

A comparison of the capabilities and limitations of the various sensing approaches that could be used results in a strong preference for a piezoelectric approach for reactor vibration measurements. A number of piezoelectric materials are available that have properties that make them desirable for reactor use. The principle advantages and shortcomings of each are discussed. (auth)

31394 (INIS-mf-845, pp 59-66) REPEATED TESTING OF NUCLEAR REACTOR PRESSURE VESSELS. Prepechal, J. (Skoda, Plzen, Czech.). [nd]. (In Czech).

Recent knowledge on periodic inspections and crack detection tests of the pressure vessels of nuclear reactors is reviewed. The importance of the tests is discussed, available methods are described, and the requirements for testing equipment are summarized. In Czechoslovakia, a project is being drafted of equipment for repeated testing of the reactor pressure vessel body designed for the VVER 1000 type nuclear power station. (INIS)

31395 (JPRS-60560, pp 84-89) DISTINCTIVE FEATURES IN PLANNING THE TURBINES OF GAS TURBINE PLANTS USING A DISSOCIATING GAS. Surovtsev, I. G. 16 Nov 1973. Translated from pp 97-103 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

Performance characteristics of gas turbine plants using a dissociating gas such as N_2O_4 are discussed. The determination of parameters for the turbines of such plants is described. (JWR)

31396 (JPRS-60560, pp 169-173) PRINCIPLES OF DINITROGEN TETROXIDE TECHNOLOGY. Trubnikov, V. P. 16 Nov 1973. Translated from pp 185-189 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

Some of the technological questions concerning the use of N_2O_4 as the coolant and working substance in nuclear power plants are examined. These include thermal and radiation effects on the coolant, effects of corrosion products and fission or activation products, coolant purification methods, and other problems. (JWR)

31397 (JPRS-60560, pp 174-180) EFFECTIVENESS OF PURIFICATION OF DISSOCIATING N_2O_4 COOLANT OF MECHANICAL IMPURITIES WITH A POROUS FLUORINATED PLASTIC FILTER. Bida, L. A.; Atroshenko, E. I. 16 Nov 1973. Translated from pp 190-196 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The removal of corrosion products from an N_2O_4 coolant using a porous fluorinated plastic filter is discussed. (JWR)

31398 (JPRS-60560, pp 181-188) EXPERIENCE IN THE OPERATION OF FITTINGS WORKING IN A LOOP WITH DISSOCIATING N_2O_4 COOLANT IN A GAS-LIQUID CYCLE. Dubrovskii, V. D.; Atroshenko, E. I. 16 Nov 1973. Translated from pp 197-204 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

The testing of pipe fittings and valves in a gas-liquid cycle loop with dissociating N_2O_4 coolant is described. Recommendations for fittings and materials for N_2O_4 cooled reactors are presented. (JWR)

31399 (RDT-E-8-15-T(2-74)) FABRICATION OF PLUG HANDLING FIXTURE FOR SODIUM COOLED REACTORS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Feb 1974. 16p. RSO.

31400 BEAM MODES OF VIBRATION OF A THIN CYLINDRICAL SHELL FLEXIBLY SUPPORTED AND IMMERSED IN WATER INSIDE OF A COAXIAL CYLINDRICAL CONTAINER OF SLIGHTLY LARGER RADIUS. Bowers, G.; Horvay, G. (Univ. of Massachusetts, Amherst). Nucl. Eng. Des.; 26: No. 2, 291-298(1974).

The beam modes of a flange-supported core-support barrel, immersed in water, are determined when the motion is confined by the surrounding reactor vessel. The narrow gap between the inner shell and the outer rigid container is responsible for a substantial increase in the virtual mass of the shell, due to motion of the entrained water. The first four natural frequencies are determined in the 'beam' approximation. 7 references. (auth)

31401 DYNAMIC BEHAVIOR OF THIN CYLINDRICAL SHELLS SUBJECTED TO IMPULSIVE BENDING MOMENTS ALONG THEIR TIPS. Suzuki, S. I. (Nagoya Univ., Japan). Nucl. Eng. Des.; 26: No. 2, 263-273(1974).

The dynamic behaviour of thin cylindrical shells with concentrated masses at their tips is investigated when they are subjected to impulsive bending moments at their tips. The relationships between the dimensions of a cylinder, concentrated mass and maximum values of dynamic stresses are obtained. The fundamental equation of motion is solved by the Laplace transformation method. From the results of the theoretical analysis, it became evident that impulsive stresses become much larger than static ones. For the case where bending moments are applied statically, the fundamental equations are also derived, taking into account the effect of shearing force. 4 references. (auth)

31402 PRACTICAL ASPECTS OF NEUTRON DETECTION AND DOSIMETRY AT THE NUCLEAR POWER STATIONS OF ELECTRICITE DE FRANCE. Guerinot, J. (Electricite de France, St-Denis, France). pp 315-325 of Neutron Monitoring for Radiation Protection Purposes. Volume I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

The various stages undergone and the measures taken in connection with neutron dosimetry at the nuclear power stations of Electricité de France since 1966 are described. In the case of graphite-moderated gas-cooled reactors, neutron fluxes in areas accessible to personnel were found to be highly localized and were made the subject of detailed systematic research when the reactors were started up. At the Chooz plant, the presence of fairly high neutron fluxes over substantial areas did not, however, raise any acute problems after the staff had been provided with an operational detector. The first stage of the safe detection of leakage fluxes was marked by the invention of a portable detector, the Maneutron, which was particularly suitable for on-site measurements in an industrial milieu. This detector was made available to the power plants in operation after the ratio between fluence rate and dose equivalent rate had been measured for the neutron fluxes concerned. The second stage will be completed when the plants have been provided with devices for the direct measurement of the dose-equivalent rate, if the forthcoming pressurized-water reactors confirm the presence of slightly higher leakage fluxes. A problem yet to be solved concerns the personal dosimetry of the operators, for which no instrument exists at present, since the neutron fluxes are such that the standard film badges or films for fast neutrons cannot be used. (auth)

31403 NEUTRON IRRADIATION OF STEEL IN NUCLEAR REACTORS. Com. Naz. Energ. Nucl., Notiz.; 20: No. 1, 45-56 (Jan 1974). (In Italian).

A brief informative report on the neutron irradiation of the steel components of the pressure vessel containing the core of a nuclear reactor is presented. (auth)

Reactor Fuels

Refer also to abstracts 29197, 29211, 29277, 30000, 30027, 31253, and 31254.

31404 (AE-RL-1326) SECONDARY FLOW VELOCITIES IN A ROD BUNDLE OF TRIANGULAR ARRAY. Hall, C.; Svenningsson, P. J. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 27 Oct 1971. 42p. Dep. NTIS (U. S. Sales Only) $5.25.

Results are presented from an experimental study of the peripheral flow velocities and the wall shear stress distribution in a triangular rod bundle with a p/D-ratio of 1,217. The experimental results are compared with the results given by the prediction method suggested by Nijsing and Eifler (1970). The experimental and predicted values did not agree. The results, i.e. the magnitude of the peripheral flow velocity, could explain the high values for the mixing factor, to be used in subchannel analysis with the HECTIC-program, reported by Ingesson (1970). 7 references. (auth)

31405 (ANL-Trans-950) DETERMINATION OF THE OPERATING TEMPERATURE OF AN IRRADIATED FUEL BY MEANS OF DISPERSED MONITORS. Flipot, A. J.; Collignon, M.; Smolders, A. Translated from J. Nucl. Mater.; 32: 268-280(1969). 17p. Dep. NTIS $4.00.

A specific isothermal line can be precisely located in a compact of irradiated UO_2, using alumina powder dispersed in UO_2 and location of the eutectic radius corresponding to the 1915°C isothermal line. The addition of a small proportion of alumina does not affect the thermal conductivity of solid uranium dioxide but has a pronounced effect on the grain size and on the columnar structure. Results are presented of thermal simulation tests and of irradiation experiments. The new method is briefly compared with the use of fusible metal wires and with the examination of the grain structure of pure UO_2. The eutectic isotherm can be located to within about 0.1 mm. (12 figures) (auth)

31406 (BAW-3647-27) PHYSICS VERIFICATION PROGRAM PART III, TASK 9. Quarterly Technical Report, April-June 1973. Baldwin, M. N.; Webb, H. W. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Research and Development Div.). Dec 1973. Contract AT(11-1)-3109. 20p. Dep. NTIS $3.00.

An experimental program is in progress to measure the fission rate in UO_2 fuel at selected positions within a critical assembly and to compare it with the neutron absorption rate in the boron of a simulated lumped burnable poison material. (11 references) (auth)

31407 (CONF-730465-, pp vp. V. 2, Paper 621) FREQUENCY AND TIME DOMAIN ANALYSIS TECHNIQUES TO ASSESS THE VIBRATION OF NUCLEAR FUEL ELEMENTS. Halliwell, G. (United Kingdom Atomic Energy Authority Reactor Group, Springfields, Eng.). [nd].

From international symposium on vibration problems in industry; Keswick, UK (10 Apr 1973).

Descriptions are given of the use of hybrid and digital equipment to reduce data obtained from sensors attached to nuclear fuel element components. The test facility is also described. Data may be periodic, random, stationary or non-stationary and may contain discrete and/or random spurious noise components. The use of a real-time hybrid spectrum analyser in conjunction with a digital computer to remove unwanted noise components is described. A novel method of displaying and recording the frequency spectra of non-stationary data is shown. The importance of the probability density function when assessing fatigue is discussed. Attempts are made to relate one parameter to another using twin channel analyzers in both the frequency and time domains. The derivation of correlation coefficients, transfer functions, and phase relationships with the aid of a digital computer is illustrated together with the use of a digital correlator to determine energy transmission paths. (UK)

31408 (INIS-mf-1152) PROGRAM OF IRRADIATION FOR THE DEVELOPMENT OF REACTOR FUELS. Sarda, V.; Mehta, S. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The general aspects of the irradiation testing for research and development work in the field of reactor fuels are outlined. The proposed experiments of irradiation are described. Brief description of the support facilities for carrying out irradiations in P. W. L. in CIRUS reactor and the irradiation experience gained so far is given. (auth)

31409 (RT/PROT-(73)28) ARIEL: CODE FOR THE STUDY OF TRANSIENT THERMAL BEHAVIOR OF A FUEL ELEMENT. Morici, A.; Principe, D.; Santarossa, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 11 Oct 1973. 58p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.00.

The ARIEL code is aimed to study the transient thermal behavior of a fuel element, when convective heat transfer coefficients, generated thermal power and coolant temperature are known as time dependent input functions. Heat transfer by radiation between rods and channel is considered. If the rod lattice is squared, the view factors are automatically computed for given values of diameter, pitch and clad surface emissivity. An example of application to an 8×8 fuel element is presented and a list of the code is included. (auth)

31410 RELEASE OF FISSION GAS FROM NUCLEAR FUELS DURING TEMPERATURE TRANSIENTS. Turnbull, J. A.; Tucker, M. O. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Materl.; 50: No. 1, 53-61(Feb 1974).

The fractional release of rare gas atoms from a spherical grain of UO_2 containing a uniform concentration of gas atoms and intragranular bubbles is calculated for short-duration temperature transients and post-irradiation annealing. The released fraction is shown to reach a small maximum value which is dependent only on the grain size, gas atom concentration, and intragranular bubble distribution. The analysis therefore may be applied to any fuel material providing these parameters are known. The conclusion therefore is that during a brief temperature transient, only a very small fraction of gas will be released from grain interiors to grain boundaries. Consequently the majority of gas released into the free volume of a pin will come from gas already residing on grain boundaries and released by mechanical cracking; the fractional gas release is small and should not cause undue concern. The conculations do not cover the case of fuel melting. (auth)

Reactor Control Systems

Refer also to abstracts 29435–29438, 29498, 29499, and 30150.

31411 (INIS-mf-1162) PHYSICS DESIGN ASPECTS OF THE 100 MW THERMAL RESEARCH REACTOR IN TROMBAY. Veeraraghavan, N.; Sankaranarayanan, S.; Paul, O. P. K.; Sen Gupta, S. N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 12p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The physics design analysis employed for the choice of an optimum core for the 100 MW thermal research reactor is presented. The design lays emphasis to achieve as maximum a neutron flux in the core as feasible for minimum heavy water and uranium inventories in the reactor vessel, while meeting the excess reactivity requirements for operational and other loads at rated reactor power. A computer program FLOEST incorporating the coupled aspects of heat transfer-core size and reactivity is developed for such optimization studies. The reactor is to be controlled by 16 to 18 stainless steel control rods. Calculational methods for the in-sequence reactivity-worths of these control/shut-off rods and their effect on the power distribution of a fully loaded core configuration are presented. Shut-down margin aspects of the control system are discussed. Measures for emergency shutdown of the reactor are studied. (auth)

31412 (JPRS-60560, pp 128-141) MODEL OF SYNTHESIS OF AN AUTOMATIC CONTROL SYSTEM FOR SINGLE-LOOP UNITS OF A HIGH-POWER ATOMIC POWER PLANT. Tokar, M. S. 16 Nov 1973. Translated from pp 144-157 of Dissotsiiruyushchiye Gazy Kak Teplonositeli i Rabochiye Tela Energeticheskikh Ustanovok.

From 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants; Minsk, USSR (Jan 1972).

In 3rd all-union conference on dissociating gases as coolants and working substances of atomic power plants.

Some of the problems in the development of automatic control systems for single-loop nuclear power plants cooled by dissociating gas are discussed. Questions in the development of such a system are examined in connection with economic considerations. (JWR)

31413 (MRR-124) USE OF PROCESS COMPUTERS IN REACTOR PROTECTION SYSTEMS. Information Meeting, Munich, Germany, March 21, 1972. (Technische Univ. Muenchen, Garching (F.R. Germany). Lab fuer Reaktorregelung und Anlagensicherung). Apr 1973. 154p. (In German). (CONF-720357-).

Separate abstracts were prepared for each of the five papers included. (JMR)

For abstracts of individual papers see: 31414–31418.

31414 (MRR-124, pp 3-42) COMPARISON BETWEEN REACTOR PROTECTION SYSTEMS WITH WIRED PROGRAMMES AND WITH FREE PROGRAMMING. Schruefer, E. Apr 1973. (In German).

From information meeting on use of process computers in reactor protection systems; Garching/Munich, F.R. Germany (21 Mar 1972).

The shutdown system of a boiling water reactor serves as an example for comparing wired and freely programmable reactor protection systems. The system consists of power supply, data acquisition, marginal checking, signal combination and the pneumatic-hydraulic scram facility. In free programming, marginal checking and signal combination are carried out by a computer, while the other functions are still done with conventional techniques. (GE)

31415 (MRR-124, pp 43-63) COMPUTER PROGRAMS FOR REACTOR CONTROL IN A REACTOR PROTECTION SYSTEM. Boehm, E.; Korpas, T.; Joergensen, U. S.; Ueberall, J. Apr 1973. (In German).

From information meeting on use of process computers in reactor protection systems; Garching/Munich, F.R. Germany (21 Mar 1972).

Computer programs for reactor control are described which compile all process information about characteristic variables relevant to safety purposes and read and store it in the computer. The stored values are compared with safety criteria. If these criteria are endangered or violated, danger signals are given or safety provisions are initiated. Finally records are made concerning all events in the reactor control system. (GE)

31416 (MRR-124, pp 65-85) RELIABILITY OF PROCESS COMPUTERS FOR REACTOR PROTECTION. Renk, K. D. Apr 1973. (In German).

From information meeting on use of process computers in reactor protection systems; Garching/Munich, F.R. Germany (21 Mar 1972).

The main difference between conventional system and those discussed here is the fact that functions executed by analog and digital units with fixed wiring are now done by the computer software. Thereby a new problem appears: Not only the hardware has to be controlled concerning reliability but also the software. Both aspects of the problem are discussed. (GE)

31417 (MRR-124, pp 87-118) POSSIBILITIES OF PROGRAMMED COMPUTER SELF CONTROL. Schueller, H. Apr 1973. (In German).

From information meeting on use of process computers in reactor protection systems; Garching/Munich, F.R. Germany (21 Mar 1972).

A computer concept for reactor protection is discussed along with possibilities to analyze reliability and suitable test programs. Furthermore, the realization of the Fail-Safe-Principle for process computers is discussed. (GE)

31418 (MRR-124, pp 119-149) TESTING OF REACTOR PROTECTION SYSTEMS WITH PROCESS COMPUTERS USING A HYBRID COMPUTER. Ehrenberger, W.; Soklic, E. Apr. 1973. (In German).

From information meeting on use of process computers in reactor protection systems; Garching/Munich, F. R. Germany (21 Mar 1972).

The testing of process computers of reactor protection systems is described. The analog part of a hybrid computer delivers analog shapes to the process computer and the digital part delivers bit patterns. The response of the process computer is transmitted to the digital part of the analog computer and the analog computer itself is controlled by the digital part of the hybrid system. In this way testing in real time is possible and the process computer is connected with all its hardware properties to the analog computer. (GE)

31419 (PWAC-403) FINAL REPORT ON LCRE CONTROL DRUM DRIVE DEVELOPMENT. Zigmond, E. J. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 13 Feb 1964. Contract AT(30-1)-2789. 71p. Dep. NTIS $6.75.

Declassified 5 Sep 1973.

The control of the LCRE was to be accomplished by ten identical rotating drums. A drum shim rate, approximating one cent per second, was determined to afford satisfactory reactor control based on nuclear calculations, critical experiments, and reactor analog simulations. Hazard studies showed that a decrease in reactivity of 3.4 percent per second, based on a time constant of 0.250 seconds, was more than adequate to handle all postulated credible accidents. Based on these studies, a gear box was designed which, in conjunction with the Harmonic Drive, provided a drum shim speed of approximately 0.67 degrees per second and a drum scram speed of approximately 36 degrees per second, using a nominal gear box reduction of 7/1. A Harmonic Drive system was used to transmit mechanical motion to the control drums through a thin-walled cylinder, thus maintaining the integrity of the reflector vessel liquid metal system. All-welded construction was used throughout the gear box and its supports, thus providing secondary containment in the event of a flex-tube rupture. All control components were designed to operate without lubrication in a high temperature, high radiation environment, thereby removing the necessity of an anxiliary cooling and lubricating system. The materials of construction including magnet wire insulation and potting compounds for all electrical components were inorganic. (auth)

31420 OPTIMAL-ADAPTIVE SYSTEM WITH PI REGULATOR. Tataru, N. N. Stud. Cercet. Energ. Electroteh.; 23: No. 4, 1025-1036(1973). (In Rumanian).

The functioning of an optimal-adaptive system constructed with a new type of regulator PI is studied with the aid of an analog model. The regulator is coupled with a simplified model of a reactor. (tr-auth)

Nuclear Power Plant Economics

31421 (AED-Conf-73-468-001) TECHNICAL AND ECONOMICAL ASPECTS OF ELECTRICITY GENERATION BY NUCLEAR POWER. Eitz, A W. 1973. 19p. (In German). INIS.

From meeting of the German Chemistry Society "energy budget and electrical heat"; Ludwigshafen, Germany (4 Oct 1973).

Based on an estimate of the primary energy demand, the share for the generation of electricity, as well as the share of nuclear energy in generating electricity for the FRG until 1985, the most important trends in the development of nuclear energy are discussed. Problems of economy, covering of the demand of uranium, and the development of advanced reactors are described. (INIS)

31422 (NIIAR-P-206) COST OF PRODUCTION AND OPTIMIZATION OF CAPITAL COSTS. Kazachovskii, O. D. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Melekess (USSR)). 1973. 10p. (In Russian). INIS.

On the basis of the examination of the balanced correlation between the expenditure and production costs for individual branches a generalized formula was obtained for the determination of the product cost which can be used in optimization calculations. The formula obtained makes it possible to calculate both the operating and capital costs. It was shown that the deduction parameter (discount norm) was determined by tempo of increase of the branch cost and therefore in the general case is different for different branches. The size of the deduction parameter is comparatively small. (tr-auth)

Reactor Fuel Cycle Economics

Refer also to abstracts 29205, 29209, 29284, 29285, 29291, 29622, and 31263.

31423 (CONF-730985-, pp vp, Paper 1) DOMESTIC URANIUM REQUIREMENTS. Neef, W. I. (Atomic Energy Commission, Washington, DC). 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

Graphs and tables are presented on U. S. energy and electricity consumption for the period from 1930 to 2000; the development of nuclear generating capacity to the year 2000; U. S. reactors expected to be in operation from 1970 through the year 2000; range of installed capacity of each type of reactor expected to be in operation in the US; and the light water separative work and uranium requirements for these reactors. (LCL)

31424 (CONF-730985-, pp vp, Paper 2) URANIUM SALES AND MARKETS. Patterson, J. A. (Atomic Energy Commission, Washington, DC). 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

Data are presented on uranium production and uses from 1968 to 1973, purchases and deliveries during 1972, and requirements to 1980 to supply existing and planned US power reactors. Information is included on the amount of U_3O_8 required for nuclear programs in the US and Japan as of January 1973. (LCL)

31425 (CONF-730985-, pp vp, Paper 9) FOREIGN URANIUM REQUIREMENTS. Neef, W. I. (Atomic Energy Commission, Washington, DC). 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

The demand for U_3O_8 in the US and foreign countries outside the Communist Bloc is estimated for each year to the year 2000 based on data for existing and planned nuclear power plants. These estimates are related to the future investment required to supply the needed fuel cycle services. (LCL)

31426 (CONF-730985-, pp vp, Paper 12) AEC NATIONAL URANIUM RESOURCE PROGRAM: NEED FOR THE PROGRAM. Nininger, R. D. (Atomic Energy Commission, Washington, DC). 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

Data are presented on US uranium requirements to the year 2000, current production and potential production in US of U_3O_8 as compared to requirements, surface drilling rates needed to maintain an 8 year forward reserve level at indicated uranium deposit discovery rates, and the potential resource program. (LCL)

31427 (CONF-730985-, pp vp, Paper 13) AEC NATIONAL URANIUM RESOURCE PROGRAM: OUTLINE OF THE PROGRAM. Grutt, E. W. Jr. (Atomic Energy Commission, Grand Junction, CO). 1973.

From AEC nuclear industry seminar; Grand Junction, Colorado, USA (6 Sep 1973).

In AEC nuclear industry seminar.

The USAEC's National Uranium Resource Evaluation Program (NURE) is planned to begin in July 1975 with the goal of providing a complete appraisal of US potential uranium resources by making more thorough geological studies and appraisals in areas warranting more study. A preliminary program to provide a rapid overview of US potential resources is to be conducted between March 1973 and July 1975. The program organization charts, field station locations, program outline, outline of report forms, projected schedules, project procedures, etc., are presented. (LCL)

31428 (TID-26542) PARTIAL FUEL STRATEGY EXAMPLE ON THE TRANSITION TO FAST BREEDER SELF-FUELING. Weills, J. T. (Argonne National Lab., Ill. (USA)). 15 May 1967. 46p. Dep. NTIS $5.50.

A total domestic industry light water reactor-fast converter-fast breeder fuel strategy example has been worked to the extent of showing nuclear fuel materials requirements for a set of postulates extrapolating contributions to electric power capacity 50 to 60 years. Fast reactor capacity is postulated to grow to 100 thousand megawatts in the 1980s with early plutonium inventory supplied from light water reactors; annual growth of the latter is assumed to decrease a factor of 3 over the decade. A fast converter type designed to take advantage of the neutronic characteristics of U-235 fuel and to produce 3 times as much plutonium as light water reactors makes up the difference in total fast reactor power demand through its power growth and through plutonium supply to breeders. When the total plutonium produced begins to exceed the demand for breeder growth, the fast converter capacity, 260 thousand megawatts, is gradually shifted to self-sustaining plutonium burners. According to these conditions, the fast breeder industry becomes self-sustaining 50 years hence, 2017. At that time the annual growth is almost equally divided between bred Pu which originated in fast converter supply and bred Pu which grew from light water reactor supply. In the context of the fuel strategy example, the breeder industry would decrease breeding rate to 5 per cent as soon as bred plutonium meets the inventory needs of capacity addition and then decrease the rate on a schedule giving 4 per cent in 5 years and 3 per cent in 12 years. Thus, the high gain breeder industry is regarded as a transient of 35 years corresponding to the period of growth to self-fueling status. The basis for this 3 reactor type strategy is the price of plutonium as demand increases following the postulated entry of fast breeders in the commercial market. A more efficient producer of plutonium than the light water reactors is forecast to limit the price rise to a level which results in electric energy cost lower than can be met by the light water nuclear steam supply stations. This outlook appears to be consistent with the postulate of commercial acceptability of the fast breeder if the efficient converter is basically very similar type; the fast converter meets this condition with the qualification that its design be altered to utilize the neutronic characteristics of U-235 to compensate for the anticipated price of this rather highly enriched fuel. (auth)

31429 URANIUM SITUATION IN THE WORLD, 1973. Com. Naz. Energ. Nucl., Notiz.; 20: No. 1, 26-30(Jan 1974). (In Italian).

The OECD's Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA) have published jointly the report on uranium resources, production, and demand in the world. Essentially similar to the preceding one, issued in September 1970, although much more detailed in its individual subjects, the new report contains updated information on the worldwide uranium picture. (auth)

Reactor Licensing and Regulation

31430 (DOCKET-50206-271) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Semi-Annual Operating Report No. 13, July 1, 1973 to December 31, 1973. (Southern California

Edison Co., Rosemead (USA)). 25 Feb 1974. 30p. Dep. NTIS $3.50.

At the start of the reporting period, the unit was shutdown to complete refueling operations. It was returned to service on July 28, at 405 MW(e) gross in compliance with an AEC directive limiting output to 90% of full power pending the Commission's review of the Cycle IV Safety Analysis including a Fuel Densification Report. The unit was released for full power operation August 21, and operated continuously until October 21, except to effect repairs of leaking pressurizer safety valves, turbine stop valves and a leaking high pressure turbine flange. The unit was removed from service October 21, due to a blade failure on a low pressure turbine and returned to service January 22, and reached full power operation (450 MW(e)) the following day. Information is presented concerning shutdowns, power generation, corrective maintenance, equipment malfunction, changes in facility design, radioactive effluent releases, environmental monitoring, and operational personnel radiation exposures. (FS)

31431 (DOCKET-50237-486) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Special Report No. 37, Analysis of Effects of Pipe Break Outside of the Primary Containment, Supplement 1. (Commonwealth Edison Co., Chicago, Ill. (USA)). 22 Mar 1974. 128p. (DOCKET-50249-376). Dep. NTIS $9.50.

31432 (DOCKET-50293-263) PILGRIM NUCLEAR POWER STATION, UNIT 1. Third Semiannual Operating and Maintenance Report, July 1, 1973–December 31, 1973. (Boston Edison Co., Mass. (USA)). 1 Apr 1974. 53p. Dep. NTIS $5.75.

Information is included on plant operations, maintenance, radioactive effluents, and personnel radiation exposures during the reporting period. (JWR)

31433 (DOCKET-STN-50480-1) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. RESAR 41, RSAR, Volume I. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). 7 Mar 1974. 347p. Dep. NTIS $20.50.

A standardized four-loop single unit NSSS for a PWR is described including the reactor core and the following systems: cooling, ECC, emergency boration, chemical and volume control, RHR, boron recycle, fuel handling, spent fuel pool cooling and cleanup, waste management, steam generator blowdown, rapid refueling, and associated instrumentation and controls for these systems. Criteria are defined for interfacing other systems and equipment with the system. The NSSS is rated at a reactor core power level of 3800 MW(t) (1295 MW(e)). The ultimate core power level for which major structures, systems, and components are described and evaluated is 4100 MW(t) (1399 MW(e)). This power rating is used in the analysis of all postulated accidents. (FS)

31434 (FIND-50275) FIND: DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Items 1-74. Williams, W. H. (Ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Apr 1974. 21p. Dep. NTIS $4.00.

This index is presented for the docket report material submitted in conjunction with the application for the Diablo Canyon Nuclear Power Plant Operating License. The index citations are to major headings and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

31435 (FIND-50302) FIND: CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNITS 3 AND 4. Items 1–116. (USAEC Technical Information Center, Oak Ridge, Tenn.). Mar 1974. 35p. Dep. NTIS $4.00.

An index is presented for technical and other report material submitted with the application for a construction permit and operating license for Crystal River Nuclear Generating Plant, Units 3 and 4. Citations refer to items and microfiche grid coordinates and are given for major headings or topics of primary interest. (auth)

31436 (FIND-50334) FIND: BEAVER VALLEY POWER STATION, UNIT 1. Items 1-102. Carter, E. P. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Mar 1974. 37p. Dep. NTIS $4.00.

A guide is given for Beaver Valley Power Station Unit 1 microfiche items received by TIC from 1969 through February 1974. This FIND covers two stages of the nuclear plant: construction permit and operating license; the more current items related to the operating-license application and the AEC review of it are indexed in more detail than the older items related to the construction-permit application and review. A categorized list of Items 1–102 (Docket 50334) is included in the table of contents. (auth)

31437 (FIND-50440) FIND: PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Items 1-51. Williams, W. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Mar 1974. 34p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc. and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

31438 (PRDI-74-4) TITLE LISTING OF POWER REACTOR DOCKET INFORMATION. (USAEC Technical Information Center, Oak Ridge, Tenn.). Apr 1974. 62p. TIC $1.45.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Atomic Energy Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (DCC)

31439 (RAI-74-3) REGULATORY ADJUDICATION ISSUANCES AND ISSUANCES OF THE BOARD OF CONTRACT APPEALS, MARCH 1974. (USAEC Technical Information Center, Oak Ridge, Tenn.). Apr 1974. 113p. TIC $2.80.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (DCC)

31440 (RDT-INDEX-3-74) INDEX OF RDT STANDARDS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Mar 1974. 48p. RSO.

The bimonthly index is a current listing of 305 RDT Standards issued through March 29, 1974. (auth)

GENERAL

Civilian Defense

31441 ROLE OF THE HEALTH PHYSICIST IN A NUCLEAR ATTACK. Gaut, H. W. (Office of Civil Defense, Olney, MD). pp 1563-1572 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Radiological Defense, or RADEF, is to Civil Defense much as Health Physics is to the radiation industry. Each accepts the premise that a situation may arise in which uncontrolled and/or excessive amounts of radiation may invade the environment of man. The difference lies in the fact that Radiological Defense requires evaluations based on criteria that differ drastically from those used in determining maximum permissible dose level for occupational exposure. While the operational policies of Civil Defense may change as the state of the art of weaponry and delivery systems advance, the threat of biological damage to man from radiation exposure is unchanging. This problem should be handled in both peace and war by trained and responsible individuals. Radiation protection after a nuclear attack requires not only an awareness of the potential character and magnitude of the problem, but an understanding of emergency philosophies, as they differ from peacetime objectives. Also since practical application requires a viable organization, the structure, mission, and limitations of such an organization at all levels of government, must be known, exercised, and routinely tested. Lastly, since radiation protection is always a support function, the relationship of Radiological Defense to the total civil defense posture must be appreciated. (auth)

Energy Utilization and Economics

Refer also to abstracts 29067, 29265, 29403, 30971–30974, 30987, 31546, and 31594.

31442 (AD-225287) NATURAL GAS AS AN AUTOMOTIVE FUEL, AN EXPERIMENTAL STUDY. Report of Investigations. Fleming, R. D. (Bureau of Mines, Bartlesville, Okla. (USA)). Oct 1973. 32p. NTIS $3.00.

A study was conducted to evaluate natural gas as an automotive fuel and to provide guidelines for optimum engine adjustments for low exhaust emissions. The study was conducted using a single-cylinder engine, a multicylinder engine, and a total of eight vehicles. Low emissions can be achieved with current-design engines by adjustment of engine parameters, but only with heavy penalty to engine performance. Air-fuel ratio, ignition timing, and ambient temperature were varied. The organic emissions from engines fueled with natural gas were estimated to be 22 to 25 percent as reactive as the emissions produced using gasoline. Levels of exhaust emissions from vehicles fueled with natural gas were unchanged over 10,000 miles of normal driving. (GRA)

31443 (AD-762586) PROJECTING CALIFORNIA'S ELECTRICAL ENERGY DEMAND. Mooz, W. E. (Rand Corp., Santa Monica, Calif. (USA)). Jan 1973. 23p. NTIS $3.25.

The methodology that was developed for the state of California for use in analyzing and estimating future electrical energy demands in the state is described. (GRA)

31444 (ANCR-1129, pp 385-389) GEOTHERMAL POTENTIAL OF THE SNAKE RIVER PLAIN AREA. Kunze, J. F.; Brugger, R. M. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

Development of the area in and around the National Reactor Testing Station will be proposed if investigations confirm the rich and economically accessible geothermal fields of mostly dry hot rock. The tapping of energy from hot dry rock or from deep poorly convective wet fields accessible at depths from 5 to 20 thousand feet should offer the potential for a virtually inexhaustible supply of energy for electric power production. The area is in a sparsely populated area, but is conducive to geothermal development for creating a model city with a clean environment. (MCW)

31445 (ANCR-1129, pp 390-395) CONCEPTUAL DESIGN OF A GEOTHERMAL DEMONSTRATION PLANT FOR THE RAFT RIVER BASIN. Kunze, J. F.; Miller, L. G.; Neill, D. T. Dec 1973.

In Nuclear Technology Division annual progress report for period ending June 30, 1973.

A preliminary conceptual design on a geothermal power plant operating with thermal water at 150°C in the Raft river valley is described. Current power plant technology allows for flashing some of the hot water to steam and to run a low pressure naval type turbine. Much heat is left in the water, and the goal is to recover the residual heat. Two possible methods are given. Calculations are given for steam obtained directly (hopefully at about 300°F) and for steam produced by flashing water from 69 psia down to 35 psia. The design of the geothermal single stage steam cycle is shown. (MCW)

31446 (ANL-8039) DEVELOPMENT OF HIGH-SPECIFIC-ENERGY BATTERIES FOR ELECTRIC VEHICLES. Progress Report, February 1973–July 1973. Nelson, P. A.; Gay, E. C.; Steunenberg, R K.; Battles, J. E.; Schertz, W. W.; Vissers, D. R.; Myles, K. M.; Kyle, M. L.; Webster, D. S.; Burris, L. (Argonne National Lab., Ill. (USA)). Dec 1973. Contract W-7405-109-eng-38. 47p. Dep. NTIS $5.45.

A high-specific-energy lithium/sulfur battery having the performance characteristics required for powering pollution-free automobiles is described. The cells currently under development have negative electrodes of molten lithium and positive electrodes of sulfur (plus an additive to reduce the sulfur vapor pressure) separated by a molten lithium halide-containing electrolyte. The operating temperature of the cells is about 400°C. The performance goals for a single cell include a capacity density of 0.4 A-hr/cm^2 at a current density of 0.1 A/cm^2, a peak power density of 1-2 W/cm^2, and a minimum cycle life of 1000 cycles. Cells with positive electrodes consisting of sulfur-arsenic-carbon mixtures in graphite housings have achieved short-time peak power densities and capacity densities that meet or exceed the goals for a single cell. A capacity density of 0.1 A-hr/cm^2 has been sustained at a discharge current density of 0.1 A/cm^2 (1-V cutoff) for more than 500 hr and 100 cycles. Improvement in cell design is needed, however, to achieve higher sulfur utilization and longer cell lifetimes. (auth)

31447 (BNL-18634) ENGINEERING-SCALE ENERGY STORAGE RESERVOIR OF IRON TITANIUM HYDRIDE. Strickland, G.; Reilly, J. J.; Wiswall, R. H. Jr. (Brookhaven National Lab., Upton, N. Y. (USA)). Feb 1974. 13p. (CONF-740306-12). Dep. NTIS $3.00.

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

A hydrogen reservoir containing 14 lb of H_2 in the form of 893 lb of granular iron titanium hydride was constructed and tested. The reservoir will be used by Public Service Electric and Gas Co. of New Jersey to study the feasibility of storing off-peak electrical energy through the use of a water electrolyzer, a hydride reservoir, and a fuel cell stack. The internal functional components of the stainless steel vessel consist of a barrier in the form of porous metal tubes, and heat exchanger tubes. Details of construction, preparation of the hydride, and performance tests made at BNL are described. (auth)

31448 (BNL-18718) TECHNOLOGY AND ECONOMICS OF HYDROGEN PRODUCTION FROM FUSION REACTORS. Powell. J.; Salzano, F. F.; Sevian, W. A. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 17p. (CONF-740306-8). Dep. NTIS $4.00.

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

The technology, economics, and environmental effects of producing synthetic fuels (H_2 gas, H_2 liquid, and methanol) based on fusion (CTR) reactors are assessed. Four U. S. energy systems (2020 AD) with different degrees of CTR implementation are compared: in System A, no CTR input is assumed; in System B, CTR's replace 50% of nuclear fission electric; in System C, CTR's supply all electrical demand, produce synthetic fuels to replace all oil and gas imports, and eliminate strip mining; and in System D, CTR's supply all electrical demand and virtually all fuel demand. CTR reactor costs are analyzed in detail for a range of containment parameters, reactor outputs, and first wall loadings for DT and catalyzed DD fuel cycles. (auth)

31449 (BNL-18725) OPERATING MANUAL FOR THE PSE AND G HYDROGEN RESERVOIR CONTAINING IRON TITANIUM HYDRIDE. Strickland, G.; Reilly, J. J. (Brookhaven National Lab.; Upton, N. Y. (USA)). Feb 1974. 40p. Dep. NTIS $5.00.

The manual was written for use with the experimental energy-storage system. Information is provided on how the reservoir functions and how it can be safely operated. In combination with a water electrolyzer and a fuel-cell stack, the hydrogen reservoir provides a new way of storing energy. The reservoir is the storage unit in the system; it is used to store hydrogen from the electrolyzer and subsequently release it to the fuel-cell stack. A reservoir for hydrogen consists of a closed vessel filled with granular metal hydride and provided with a particle barrier, a gas connection, and a means of handling the necessary thermal load. In this case the hydrogen is stored as iron titanium hydride in a pressure vessel; porous metal tubing is used for the barrier, and an internal heat exchanger is provided to handle the thermal load. The hydride may be cycled many times provided gaseous impurities that degrade its performance are excluded from the system. Water at readily available temperatures (approximately 60 and 120°F) is suitable for use as the heat exchange medium. Tests have shown that design specifications may be exceeded. It will take up H_2 at a rate >1.5 lb/hr, deliver it at a rate >1.0 lb/hr, and its working capacity is significantly more than the 10 lb of H_2 originally specified. A compressor (500-psig rating) is required to pressurize H_2 leaving the electrolyzer in order to obtain a practical sorption rate. The temperature and flow rate of the water in the heat exchanger tubes also are an important factor with respect to sorption and desorption rates. (MCW)

31450 (BNL-18734) SOLAR POWERED STEAM SUPPLEMENT FOR THE BNL STEAM PLANT. Cottingham, J. G.; Green, G. K. (Brookhaven National Lab., Upton, N. Y. (USA)). 15 Mar 1974. 26p. Dep. NTIS $4.50.

Solar energy converted to commercial steam can be distributed and used by existing equipment to heat and cool buildings. This forms a ready economical market for an otherwise expensive energy source. Component designs and system plans are outlined using an elevated boiler and reflectors that track the Sun. (auth)

31451 (COM-73-11353-2) OFFSHORE DRILLING: A BIBLIOGRAPHY WITH ABSTRACTS. Report for 1964–May 1973. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Jul 1973. 29p. (NTIS-WIN-73-9). NTIS $20.00.

The NTISearch bibliography contains 25 selected abstracts of research reports retrieved using the NTIS on-line search system–NTISearch. The abstracts are primarily concerned with the environmental effects from offshore drilling. (GRA)

31452 (COM-73-11490-2-GA) AUTOMOBILE AIR POLLUTION: A BIBLIOGRAPHY WITH ABSTRACTS. Report for 1970–May 1973. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Jul 1973. 146p. (NTIS-WIN-73-34). NTIS $20.00.

The NTIS bibliography contains 134 selected abstracts of research reports covering the period 1970 to May 1973 retrieved using the NTIS on-line search system–NTISearch. The abstracts are broken down into five sections covering the abatement and control of automobile exhaust: General studies (27 abstracts); Urban transportation planning and management (30 abstracts); Control methods (19 abstracts); Automotive fuel effects, additive effects, and new fuel types (23 abstracts); New engines (18 abstracts); and Exhaust analysis (17 abstracts). Smog and diesel engine research is excluded. (GRA)

31453 (COM-73-11582-6-GA) DISPOSAL AND UTILIZATION OF WASTES FROM ENERGY PRODUCTION: A BIBLIOGRAPHY WITH ABSTRACTS. Report for 1970–May 1973. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Aug 1973. 84p. (NTIS-WIN-73-39). NTIS $20.00.

The NTISearch bibliography contains 78 selected abstracts of research reports retrieved using the NTIS on-line search system—NTISearch. The bibliography presents generalized studies concerning environmental factors of both thermal and nuclear power plants. These studies cover the abatement and control techniques for water pollution, air pollution, and solid waste. Not included are overly specific studies, biological effects, or studies not applicable to more than one plant. (GRA)

31454 (COM-73-11691-5-GA) OIL SHALE: A BIBLIOGRAPHY WITH ABSTRACTS. Report for 1964–May 1973. Ringe, A. C. (National Technical Information Service, Springfield, Va. (USA)). Aug 1973. 65p. (NTIS-WIN-73-50). NTIS $20.00.

The bibliography contains 60 selected abstracts of research reports retrieved using the NTIS on-line search system–NTISearch. The reports selected cover all phases of oil shale research, including exploration, mining, retorting, chemistry, environmental impacts, and policies. (GRA)

31455 (CONF-740406-1) STUDY OF OPTIONS FOR CONTROL OF EMISSIONS FROM AN EXISTING COAL-FIRED ELECTRIC POWER STATION. Salmon, R.; Nichols, J. P. (Oak Ridge National Lab., Tenn. (USA)). 1974. 25p. Dep. NTIS $4.25.

From second AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

Alternatives for the reduction of sulfur oxide emissions from an existing 1300-MW coal-fired power station are compared with respect to technological feasibility, practicality, and cost. The principal options available for near-term (1975-1977) application are the use of (1) low-sulfur fuel oil derived from petroleum, or (2) low-sulfur western coal. The use of low-sulfur fuel oil is technologically feasible, but the long-term outlook is for continued scarcity, high price, and unreliability of supply. Operational problems with low-sulfur coal may cause derating of plants designed for eastern coals. Stack gas treating processes such as scrubbing with limestone slurry do not yet have the degree of operating reliability needed for power plant use. It is estimated that processes for treating stack gas may achieve 90% reliability by about 1976, but implementation by 1977 would require selection of a process and initiation of engineering by about 1974-1975. Among the longer-term options, low-Btu gas has the advantage of a high degree of sulfur removal and the potential for future use in cycles of high efficiency. Solvent refined coal appears to have considerable potential, assuming that pilot-plant operations are successful. Liquid fuels from coal have promise not only for power plant use but also for easing the long-term shortage of liquid fuels for the transportation sector. (auth)

31456 (COO-2309-1) ELECTRICAL POWER GENERATION IN WISCONSIN: THE CHALLENGE OF MEETING PRESENT NEEDS AND FUTURE DEMANDS. Final Report, March 1, 1973–February 28, 1974. Lee, L. R. (Wisconsin Academy of Sciences, Arts and Letters, Madison (USA)). 1974. Contract AT(11-1)-2309. 63p. Dep. NTIS $6.25.

Six symposia covering Electrical Power Generation in Wisconsin: the Challenge of Meeting Present Needs and Future Demands were held during the 1973-74 school year. Each symposium was held in a different area of the state. A generalized program included: Environment Costs and Trades of Energy Use; Energy and Wisconsin–Today and Tomorrow; and Power Sources for Electricity–Promises and Problems. (MCW)

31457 (COO-3326-27) PROSPECTS OF PHOTOSYNTHETIC ENERGY PRODUCTION. Kok, B. (Martin Marietta Labs., Baltimore, Md. (USA)). 1974. 10p. (CONF-740213-4). Dep. NTIS $4.00.

From 140th meeting of The American Association for the Advancement of Science; San Francisco, California, USA (25 Feb 1974).

The relevant aspects of photosynthesis are reviewed, the prospects for expanded exploitation of natural solar conversion systems are evaluated, and some avenues for needed research are suggested. The cheapest, largest, and most successful solar energy conversion system available is photosynthesis. Photosynthesis is not an efficient energy source. One approach examined was the search for increased yield of combustibles (e.g., woody plants) and another was the interference with photosynthetic processes so that combustible gases like hydrogen or methane were produced. (MCW)

31458 (EIS-CA-73-1681-F-1-GA) GEOTHERMAL LEASING PROGRAM. Volume I. Promulgation of Leasing and Operating Regulations. Final Environmental Impact Statement. (Department of the Interior, Washington, D. C. (USA)). 24 Oct 1973. 519p. GPO $4.20.

Volume I of this statement primarily relates to the promulgation of leasing and operating regulations for implementation of the geothermal leasing program as authorized by the Geothermal Steam Act of 1970. The proposal is described in Chapter I. The national energy situation, geothermal energy resources and their potentials, description of resource development and production phases, and a broad description of the environmental setting of the western states are included in Chapter II. The promulgation of leasing and operating regulations, the environmental impacts of the proposed action, mitigating measures, adverse impacts which cannot be avoided, the relationships between local short-term uses of man's environment and maintenance and enhancement of long-term productivity, and irreversible and irretrievable commitments of resources are discussed in detail in Chapter III. Chapter IV includes discussions of alternatives for timing of actions, environmental provisions of regulations, leasing options, Federal and private exploration and development, and electrical energy sources. (GRA)

31459 (EIS-CA-73-1681-F-2-GA) GEOTHERMAL LEASING PROGRAM. Volume II. Leasing of Geothermal Resources in

Three California Areas. Final Environmental Impact Statement. (Department of the Interior, Washington, D. C. (USA)). 24 Oct 1973. 547p. GPO $5.85.

This volume of the Geothermal Leasing Program final impact statement contains the individual environmental statements for the leasing of federally owned geothermal resources for development in three specific areas: (a) Clear Lake-Geysers; (b) Mono Lake-Long Valley; and (c) Imperial Valley, all in California. It also includes a summary of the written comments received and departmental responses relative to the Draft Environmental Impact Statement issued in 1971; comments and responses on the Draft Environmental Impact Statement; consultation and coordination in the development of the proposal and in the preparation of the Draft Environmental Statement; and coordination in the review of the Draft Environmental Statement. (GRA)

31460 (EIS-CA-1681-F-3-GA) GEOTHERMAL LEASING PROGRAM. Volume III. Appendices A Through H. Proposed Geothermal Leasing and Operating Regulations. Final Environmental Impact Statement. (Department of the Interior, Washington, D. C. (USA)). 24 Oct 1973. 701p. GPO $5.60.

The following topics are discussed: July 23, 1973, proposed leasing regulations; July 23, 1973, proposed operating regulations; comments on July 23, 1973, proposed regulations; November 29, 1972, proposed leasing regulations; November 29, 1972, proposed operating regulations; comments on November 29, 1972, proposed regulations; July 23, 1971, proposed leasing and operating regulations; May 3, 1972, proposed unit plan regulations; summary of comments and departmental responses; vapor dominated hydrothermal systems; classification of public lands. (GRA)

31461 (EIS-CA-73-1681-F-4-GA) GEOTHERMAL LEASING PROGRAM. Volume IV. Appendix I. Comments on Draft Impact Statement and Proposed Regulations. Final Environmental Impact Statement. (Department of the Interior, Washington, D. C. (USA)). 24 Oct 1973. 728p. GPO $5.65.

This volume contains comments received from Federal, State, local and individual interests on the leasing and operating regulations and the Draft Environmental Impact Statement for the Geothermal Leasing Program and the supplement to the draft statement. (GRA)

31462 (LA-UR-73-1362) LABORATORY TEST APPARATUS FOR A SUPERCONDUCTING DC TRANSMISSION LINE. McDonald, T. E.; Kerr, E. C.; Trela, W. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 5p. (CONF-740108-1). Dep. NTIS $3.00.

From winter power meeting; New York, New York, USA (27 Jan 1974).

The Los Alamos Scientific Laboratory has recently initiated a program to study the technical and economic feasibility of a dc superconducting power transmission line. As part of the program, a large sample testing apparatus has been constructed consisting of a test bed that is approximately 10 m long and can hold a 20 m sample in a race track arrangement; high current potheads that go from room temperature to cryogenic temperature; and a high current source. The test bed and associated apparatus and a summary of the test procedures to be used are described. (auth)

31463 (LA-UR-73-1500) DEVELOPMENT PROJECT FOR A DC SUPERCONDUCTING POWER TRANSMISSION LINE. McDonald, T. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 8p. (CONF-740410-1). Dep. NTIS $4.00.

From underground transmission and distribution conference; Dallas, Texas, USA (Apr 1974).

A dc superconducting power transmission project that is in progress at the Los Alamos Scientific Laboratory is described. The project is directed toward the development of a system that would primarily be used for long-distance high-capacity transmission. A discussion of the advantages of a dc superconducting transmission line is given and preliminary cost estimates of a conceptual design are presented. (auth)

31464 (LA-UR-74-340) CRYOGENICS SAFETY IN A HYDROGEN FUEL SOCIETY. Reider, R.; Edeskuty, F. J.; Williamson, K. D. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 20p. (CONF-740509-1). Dep. NTIS $3.00.

From fifth international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

An inevitable world-wide shortage of fossil fuel and concern for environmental pollution have aroused interest in hydrogen as a synthetic clean fuel. The storage, shipment, and use of hydrogen in a cryogenic fluid have already been demonstrated to be feasible and safe. To make liquid hydrogen a universally attractive fuel requires only an extension of existing technology. The fundamentals of cryogenic safety with specific attention to hydrogen are reviewed with respect to material properties, control of ignition sources, management of leaks, inerting and ventilating, analysis of spills, cold injury, air condensation and oxygen enrichment, pressure relief and thermal stresses. Problems of standards and regulations, safety training, development of operating procedures, and emergency plans must be addressed thoroughly before the common use of liquid hydrogen will receive public acceptance. The nature and consequences of hydrogen accidents are analyzed. (auth)

31465 (LA-UR-74-503) INSTRUMENTATION FOR GRANITE TEST NO. 1. Dennis, B. R.; Potter, R. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 23p. (CONF-740504-2). Dep. NTIS $4.25.

From 20th international instrumentation symposium; Albuquerque, New Mexico, USA (21 May 1974).

Initial measurements to evaluate the feasibility of extracting energy from hot-dry rock in Precambrian basement (granite) employing hydraulic-fracturing techniques were explored in the LASL Granite Test Hole No. 1. Following a series of hydrology experiments in the 785-m (2575 ft) depth hole, preparations were made to instrument a series of hole-pressurization and hydraulic-fracturing experiments. The instrumentation was designed to measure breakdown pressure, crack-extension pressure, and shut-in pressure for each fracture and to determine principle tectonic stresses, breakdown stress for hydraulic fracturing, and leak-off rate for fracturing fluid. (auth)

31466 (LA-UR-74-528) LONG RANGE CONSIDERATIONS AND POSSIBILITIES OF HYDROGEN ECONOMY. Edeskuty, F. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 10p. (CONF-740119-1). Dep. NTIS $4.00.

From annual compressed gas association meeting; San Francisco, California, USA (28 Jan 1974).

Some available technology and uses of hydrogen to help relieve the energy problems are discussed. Electrical peak-shaving with hydrogen use means that any off-peak excess electrical power output would be used to electrolyze water. The resulting hydrogen and oxygen would be stored as liquids, as compressed gases or, in the case of hydrogen, as metal hydride. Electricity would be generated by the combustion of the stored hydrogen and oxygen to drive a high speed, high efficiency turbine. An alternate method would be the use of hydrogen and oxygen in a fuel cell. The use of hydrogen in aircraft and surface transportation in all its forms and the advantages and disadvantages are discussed. Hydrogen as a fuel in an internal combustion engine presents an efficiency factor sometimes quoted to be 50 percent. The safety parameters of hydrogen are compared with gasoline. Economy and public acceptance are discussed. The USA produced hydrogen in huge quantities that was utilized by the space program in the past decade. (MCW)

31467 (ORNL-NSF-EP-66) ENERGY CONSERVATION AND THE ENVIRONMENT. Progress Report, December 31, 1973. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 76p. Dep. NTIS $7.00.

Emphasis was mainly placed on opportunities for energy conservation in the transportation and residential sectors. Preliminary results for a highly disaggregated model of the TVA service area were obtained for the electricity demand growth. The research on policy alternatives in coal mining is discussed. The chapter on Energy Conservation Analysis contains sections on energy uses for automobiles, bicycles, and aircraft; total energy requirements of air transport; residential energy conservation; and energy use for food. From the discussion on Demand for Electricity, information is included on effect of rate structure; applicability of the national electric demand models to the TVA service area; data base and preliminary results in TVA area demand study; and communication and implementation of findings. Evaluation of alternative reclamation techniques, an overview on the role of coal, and implementation activities are discussed under Coal Mining and the Environment. Energy information and program publications are included. (MCW)

31468 (ORNL-TM-4370, pp 281-287) HYDROGEN PRODUCTION. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

Research on enzymatic and thermal hydrogen production is reported. (LK)

31469 (ORNL-TM-4370, pp 472-474) COAL CONVERSION STUDIES. Ferris, L. M.; Bennett, M. R.; Thompson, C. T. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

Studies of the conversion of coal to liquid and gaseous fuels by catalyzed and pressurized hydrogenation have been initiated. Preliminary studies have been made on the use of HF in the gas-

eous mixture to accelerate the hydrogenation process. HF concentrations up to 20 mole % did not have a favorable effect. (auth)

31470 (PB-224006-7-GA) ELECTRIC POWER UNIT COMMITMENT SCHEDULING USING A DYNAMICALLY EVOLVING MIXED INTEGER PROGRAM. Final Report. Gruhl, J. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1973. 150p. NTIS $4.50.

A quasi-optimal technique, realized by a dynamically evolving mixed integer program, develops regional electric power unit commitment schedules for a 1-week time span. Associated with a tradeoff between a given cost of production and the relevant ecological factors, an optimum generation schedule is formulated that considers fossil, nuclear, hydro, gas turbine, and pumped hydro facilities; power demands, reliabilities, operating constraints, startup and shutdown factors, geographic considerations, as well as various contract possibilities such as interregional power exchanges, interruptible loads, gas contracts, and optimum nuclear fuel batch utilization. A prerequisite of the model was that it be flexible enough for use in the evaluation of the optimum system performance associated with hypothesized expansion patterns. Another requirement was that the effects of changed scheduling factors could be predicted and, if necessary, corrected with a minimal computational effort. (Portions of this document are not fully legible). (GRA)

31471 (PB-224079-4-GA) ELECTRIC GENERATION PRODUCTION SCHEDULING USING A QUASI-OPTIMAL SEQUENTIAL TECHNIQUE. Final Report. Gruhl, J. (Massachusetts Inst. of Tech., Cambridge (USA)). Apr 1973. 154p. NTIS $4.75.

A quasi-optimal technique, realized by a dynamically evolving mixed integer program, is used to develop regional electric power maintenance and production schedules for a 2- to 5-year planning horizon. The power system considered is a regional pool of closely coupled facilities. Associated with a tradeoff between a given cost of production and the relevant ecological factors, an optimum production scheduler is formulated that considers fossil, nuclear, hydro, gas turbine, and pumped hydro generation facilities; power demands, reliabilities, maintenance and refueling requisites; labor coordination, geographic considerations, as well as various contracts such as interregional power exchanges, interruptible loads, gas contracts, and nuclear refueling contracts. A prerequisite of the model was that it be flexible enough for use in the evaluation of the optimum system performance associated with hypothesized expansion patterns, that is, production cost. Another requirement was that the effects of changed scheduling factors could be predicted and corrected with a minimum computational effort. (Portions of this document are not fully legible). (GRA)

31472 (PB-224399-6-GA) BUREAU OF MINES ENERGY PROGRAM, 1972. Linville, B.; Spencer, J. D. (Bureau of Mines, Washington, D. C. (USA)). Aug 1973. 117p. NTIS $4.25.

During calendar year 1972, the Bureau of Mines was engaged in some 20 major areas of research for development of new and improved efficient methods of conservation and utilization for petroleum and natural gas, oil shale, and coal. Made up of numerous projects described in this report, the program was carried out through research centers and laboratories in the field supervised and supported by administrative personnel of this Bureau of the Department of the Interior. Based on this research, 186 technical reports were published by the Bureau or others, and numerous other reports were prepared for U. S. Government agencies, state agencies, and organizations engaged in cooperative research programs with the Bureau. (GRA)

31473 (PB-224530-6-GA) CLEAN FUELS FROM COAL. Cochran, N. P. (Office of Science and Technology, Washington, D. C. (USA)). 10 Nov 1972. 15p. NTIS $3.00.

A study of the production of clean synthetic fuels from coal resulted in recommendations for a total program of $1.51 billion. The work recommended is divided into a research phase at $33.4 million, a development phase at $315.0 million, and a demonstration phase at $1.15 billion. Work is outlined for alternate processes to produce clean low-Btu gas, clean liquid fuels, and clean solid fuels from coal. Supporting work on the development of special equipment and improved materials along with economic and engineering studies are proposed and funds provided in the budget estimates. (GRA)

31474 (PB-227172-4-WE) RESIDENTIAL DEMAND FOR ELECTRICITY IN NEW ENGLAND. Levy, P. F. (Massachusetts Inst. of Tech., Cambridge (USA)). Nov 1973. 124p. (MIT-EL-73-17). NTIS $3.25.

The residential demand for electricity at a very detailed level of aggregation is examined. An econometric model is developed for the New England region using a cross-section of sixty-seven electric utilities and their service areas as the data base. Both supply price and demand equations are estimated, using the two-stage least squares technique, to account for the simultaneous nature of the system. Conclusions are presented and policy implications discussed. Suggestions for future work in the field are also presented. (NTIS)

31475 (SLA-74-91) SOLAR COMMUNITY: ENERGY FOR RESIDENTIAL HEATING, COOLING, AND ELECTRIC POWER. McCulloch, W. H.; Lee, D. O.; Schimmel, W. P. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 18p. (CONF-740213-3). Dep. NTIS $3.00.

From 140th meeting of The American Association for the Advancement of Science; San Francisco, California, USA (25 Feb 1974).

A series of systems studies on the potential uses of solar energy was conducted at Sandia Laboratories. The outcome of these studies is a new concept, the Solar Total Energy Community. This is a residential community which could significantly reduce its fossil fuel energy consumption by using the sun as the source for most of the community's energy needs. A system computer program, developed for the study, was used to examine several candidate systems and to optimize the operation of the interrelated components which provide space heating, air conditioning, water heating, and electricity for residences and light commercial buildings. An experimental program has been initiated to investigate various technological areas relative to the concept. The study shows that the Solar Community is technologically feasible and that the projected costs warrant the further investigation of solar energy as an alternative residential energy source. This paper reviews the previous work, reports recent findings and improvements, and presents the current status of the continuing analytical and experimental efforts. (auth)

31476 (SLA-74-124) SOLAR TOTAL-ENERGY COMMUNITY PROJECT. Brandvold, G. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 9p. Dep. NTIS $4.00.

The concept of a solar total-energy community entails collecting solar energy at a central area, converting part of it to electricity, and distributing the rest of it to homes and/or businesses for space heating or cooling. The Sandia Laboratories' concept for such uses of solar energy, its departure from other solar-energy approaches, and the development program being conducted to further explore its feasibility are described. (auth)

31477 (SLA-74-125) PROGRAM PLAN FOR IMPROVING DEEP DRILLING. Newsom, M. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 11p. Dep. NTIS $4.00.

There is increasing interest in the development of methods of drilling for oil and gas at depths below 5000 feet. The program proposed here would attempt to reduce both the time and the costs associated with deep well drilling. The methods proposed for investigation comprise (1) shocks generated by electrical detonations and subsequent cavitation, (2) the use of a continuous-belt drill bit, (3) a terradynamics drilling system, and (4) nondestructive testing and materials analysis. (auth)

31478 (SLA-74-194) EXPERIMENTAL RESISTIVITY ELECTRODE EMPLACEMENT FOR THE HAWAII GEOTHERMAL PROJECT. Brandvold, G. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1974. Contract AT(29-1)-789. 8p. Dep. NTIS $4.00.

Sandia Laboratories' expertise in Earth-penetrating projectiles has been applied to problems of geothermal resource research. Field trials of an experimental terradynamics electrode for resistivity surveys have been carried out in cooperation with the Hawaii Institute of Geophysics, and the design of an instrumented magma penetrometer begun. (auth)

31479 (TID-26528) REPORT OF THE CORNELL WORKSHOPS ON THE MAJOR ISSUES OF A NATIONAL ENERGY RESEARCH AND DEVELOPMENT PROGRAM, September 14, 1973–October 17, 1973. (Cornell Univ., Ithaca, N. Y. (USA). Coll. of Engineering). Dec 1973. 263p. TIC.

The purpose of the workshop was to develop information that would provide independent assessment of the stated options for the ultimate development of an integrated energy R&D program, for the nation. After a presentation of an overview of an integrated national energy R&D program, a summary is given of the four workshop areas on fossil fuel option, the short-term nuclear option, the advanced nuclear power, and energy R&D institutional patterns. Separate abstracts were prepared for the five papers. (MCW)

For abstracts of individual papers see: 31480–31484.

31480 (TID-26528, pp 1-73) OVERVIEW OF AN INTEGRATED NATIONAL ENERGY RESEARCH AND DEVELOPMENT PROGRAM. Chapter I. Auer, P. L. (Cornell Univ., Ithaca, NY). Dec 1973.

In report of the Cornell Workshops on the major issues of a national energy research and development program, September 14, 1973–October 17, 1973.

An attempt was made to structure a well-balanced effort aimed at supporting a near-term objective while maintaining both mid-term and long-term objects. The current energy crisis creates another thought that suggests that a maximum emergency measure should be adopted to reduce anticipated shortfalls in natural gas and oil, and create a synthetic fuel industry. These are not in the realm of R&D. It is deemed possible to start design and construction of first-generation plants immediately. By 1985, ten to eighteen oil shale extraction plants each with 100,000 bls of oil per day capacity requiring $500 to $600 million capital per plant could be a reality. Also eighteen to twenty-six high-Btu gas plants each with 250 million cu feet per day capacity requiring some $500 million capital per plant, mine included, and another approximate $100 million if deep mining is necessary, could be in operation. Legislation would be required that would allow construction of these plants as demonstration plants. The general categories applying to R and D programs are discussed in the general sections of conservation, fossil fuel option, nuclear option, and renewable resources. (MCW)

31481 (TID-26528, pp 75-129) FOSSIL FUEL OPTION. Chapter II. Perry, H. (National Economic Research Associates, Washington, DC). Dec 1973.

In report of the Cornell Workshops on the major issues of a national energy research and development program, September 14, 1973–October 17, 1973.

The nation will continue to be dependent upon fossil fuels for the next twenty to thirty years. Conservation will provide the time needed to bring the new, cleaner energy sources and technology into use. New environmental regulations will increase energy resource requirements until new processes are developed that are less energy intensive per unit of product. A summary of fossil fuel energy resources for proved; proved and probable; and proved, probable, and possible is given. New methods for increasing oil and gas reserves; deep and strip coal mining; utilization of coal by direct combustion, gasification, and liquefaction; oil shale development; and environmental considerations are discussed. Appendices to Chapter II include the rate at which strip mining capacity could be increased and strategy for coal research and development. A cost summary is included. (MCW)

31482 (TID-26528, pp 131-167) SHORT-TERM NUCLEAR OPTION. Chapter III. Weinberg, A. M. (Oak Ridge National Lab., TN). Dec 1973.

In report of the Cornell workshops on the major issues of a national energy research and development program, September 14, 1973–October 17, 1973.

The USA has in operation, under construction, or firmly committed more than 150,000 MWe nuclear power to come into operation in the 1980's indicating 17 to 20 percent of the entire energy budget of the nation. To reduce the dependence on oil imports, it is stated that overall use of energy must be reduced, additional supplies of domestic oil from the ground or by conversion of coal are necessary, or substitution of energy from coal and uranium are necessary. The reactors that are available now will be replaced with breeders and controlled fusion reactors in the long haul. Data concerning uranium and uranium reserves were discussed and it was concluded that the single most vulnerable part of the nuclear enterprise is the uncertainty as to the availability of uranium ore. Availability of separative work capacity, adequacy of industrial manufacturing capacity, environmental impact, safety, and cost were reviewed. Comments on the paper are published in an appendix. (MCW)

31483 (TID-26528, pp 169-219) ADVANCED NUCLEAR POWER. Chapter IV. Bethe, H. A. (Cornell Univ., Ithaca, NY). Dec 1973.

In report of the Cornell workshops on the major issues of a national energy research and development program, September 14, 1973–October 17, 1973.

The view is presented that the fast breeder and the fusion reactor are the only forms of technology now in sight that will give long-range, ample sources of energy. The feasibility of fusion has not been established. The LMFBR progress has been slow. High-grade uranium ore sources may become short in two to three decades if the ores continue to be needed in LWRs, etc. So with the technology of the breeder at hand, it is urgent that these be developed now. The most important characteristic of the breeder is the doubling time, the time it takes for the amount of fissile material to double. Technological, safety, and economic comparisons of the breeder and fusion reactors are made. Research on laser fusion and fusion by magnetic confinement are discussed with the laser fusion military applications indicated. Uranium ores; breeder calculations; the Doppler effect; Doppler effect and hypothetical accident; brief history of the breeder; history of laser-fusion; and future demand for uranium ore are subjects covered in the appendices. (MCW)

31484 (TID-26528, pp 221-242) ENERGY RESEARCH AND DEVELOPMENT INSTITUTIONAL PATTERNS. Chapter V. Paine, T. O. (General Electric Co., New York). Dec 1973.

In report of the Cornell Workshops on the major issues of a national energy research and development program, September 14,–October 17, 1973.

It is stated that a highly goal-oriented organization and management is needed to facilitate assessment, coordination, and direction of the many complex activities that will be carried out by diverse groups in many locations. The responsibilities of the federal government; cabinet-level department of energy and natural resources; agency for energy R&D; technology assessment carried out by high government; industry; cooperative industrywide R&D; private corporate R&D; and assessment of institutional capability are described. The objectives of the USA energy R&D entail environmental and safety standards; synthetic oil and gas from coal and oil shale; synthetic nuclear fuel from uranium and thorium; energy conservation and conversion; and R&D on equipment, systems, and processes. (MCW)

31485 (UCID-16094) THERMODYNAMIC EQUILIBRIA FOR WYOMING COAL. Stephens, D. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Aug 1972. Contract W-7405-eng-48. 39p. Dep. NTIS $5.00.

As part of the program to evaluate in situ gasification of coal, the thermodynamics of Wyoming coal was calculated for pressures from 1 to 70 atm, temperatures from 600 to 1600°K, and varying steam-oxygen-coal compositions. Coal was not stable relative to carbon under any of the conditions investigated. Conditions favoring methane production included higher pressures, lower temperatures, and lower oxygen-to-water ratios. Calculated methane production was sensitive to the stability of carbon allowed to exist in the solid phase. If equilibria were frozen in the underground system at 30 atm and temperatures of 500°C or less, it is calculated that sufficient methane would be formed that surface methanation facilities would not be required. Higher-temperature equilibria would require these surface facilities. (auth)

31486 (UCID-16155) THERMAL WAVE PROPAGATION MODELS FOR IN SITU COAL GASIFICATION. Sherwood, A. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Oct 1972. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

The dynamics of in situ coal gasification is discussed for simplified models, assuming the coal deposit can be treated as a fixed-bed chemical reactor. A thermal wave is shown to propagate at a characteristic velocity much smaller than the gas velocity and of the order of a few feet/hour. Peak temperature and width of the wave are calculated for first and second order reaction kinetic models, assuming a single overall coal reaction. The thermal wave is broadened by the estimated low heat transfer rate between gas and solid. Calculated coal heating rates are on the order of a few degrees centigrade/hour. (auth)

31487 (UCID-16428) ELEMENTS OF THE WORLD ENERGY CRISIS. Werth, G. C.; Green, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jan 1974. Contract W-7405-eng-48. 31p. Dep. NTIS $4.75.

The chain of events leading to the world energy crisis is followed for each industrialized country and the effects that energy shortages are presenting and options that are available are identified. The Soviet Union has extensive oil and gas reserves and the USA has extensive fossil fuel reserves, but needs to develop technology for coal and shale. Western Europe has been dependent upon Middle East oil, but could develop their coal resources. Japan is dependent upon oil imports, and with the advanced prices of oil, the capital on that island needs to be used internally in improving living conditions. (MCW)

31488 (UCRL-51520) HYDROEXPLOSIVE MINING: A METHOD FOR DEVELOPING DEEP, THICK SEAMS OF COAL. Archibald, P. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Mar 1974. Contract W-7405-eng-48. 18p. Dep. NTIS $4.00.

Hydroexplosive mining is suggested as one way to economically develop deep, thick seams of coal without adversely affecting the environment. It is also considered as an alternative to strip mining. Hydroexplosive techniques are examined and some preliminary experiments are described. (auth)

31489 (UCRL-75095) THERMOCHEMICAL HYDROGEN PRODUCTION RESEARCH AT LAWRENCE LIVERMORE LABORATORY. Hickman, R. G.; Krikorian, O. H.; Ramsey, W. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1974. 13p. (CONF-740306-7). Dep. NTIS $4.00.

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

Three novel closed-cycle processes for the thermochemical production of hydrogen from water are under study at the Lawrence Livermore Laboratory. The first cycle is based upon selenium and its compounds, the second on mercury, and the third on methane and methanol. None of these cycles involves halogens, and reaction temperatures are limited to 700°C. Although still in the conceptual stages, some preliminary experiments have been conducted on the first two processes, with the main effort on the first process. (auth)

31490 (UCRL-75242(Rev. 1)) OUTLOOK FOR OIL SHALE. Lewis, A. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Feb 1974. 13p. (CONF-740213-2). Dep. NTIS $4.00.

From 140th meeting of The American Association for the Advancement of Science; San Francisco, California, USA (25 Feb 1974).

The extent to which oil from domestic oil shale will provide energy in the future depends as much on national and regional political decisions, as it does on technical or economic issues. Technology available to industry in this decade can be used to ensure a modest supply of oil from oil shale at present prices and with a total reserve of about 54 billion barrels of oil, if some government land is made available and environmental requirements are defined. The capability of developing technology within this decade to produce oil in large enough quantity and at low enough cost to exert a major influence on the national and international oil market exists. In situ processes and/or massive open-pit technology would open up a much larger resource (200 to 800 billion barrels) within a small area (600 mi^2) of Colorado. Development of this technology is beyond the capability of industry alone and will require a definition of the role of government and industry in the planning, management, production, and ownership of the resource. (auth)

31491 (UCRL-75494) IN-SITU COAL GASIFICATION. Stephens, D. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Jan 1974. 30p. (CONF-740118-1). Dep. NTIS $4.50.

From tri-state fossil fuels energy conference; Denver, Colorado, USA (31 Jan 1974).

Two approaches to in-situ coal gasification are reviewed. The first is improvement of existing Russian technology, and the second is development of a new method based on explosive fracturing. The Russian techniques developed as early as 1935, generally involved gasification of coal between boreholes by use of hydraulic or air fracturing. These installations made a combustible gas of the order of 100 Btu/scf, and this gas was primarily used for electrical power generation. However, the product gas flow rate fluctuated and the heating value generally decreased with time. This made for inefficient power production, and the process was not competitive with the oil and gas discoveries made in Russia during the late 1950's. American experiments using Russian techniques, were conducted by the U. S. Bureau of Mines during the 50's in Gorgas, Alabama. They confirmed the Russian results. The Lawrence Livermore Laboratory concept for in-situ coal gasification is to use chemical explosives in an array of drilled holes to fracture coal at depths from 1000 to 2000 ft. The top of the resulting permeable fractured area would be ignited and then a steam-oxygen mixture would be continuously supplied at 500 to 1000 psi pressure. In essence, the concept represents an underground packed bed reactor. The coal in the fractured bed would be gasified with steam and oxygen just as in conventional high-Btu coal gasification. The gases produced underground should consist primarily of methane, carbon monoxide, carbon dioxide, and hydrogen, and they would be treated in a surface facility to produce pipeline-quality gas. The projected selling price of the gas ranges from 50 to 70¢/mcf (or per million Btu). The upper estimate, 70¢/mcf, is only two-thirds the projected cost of gas produced by the modern United States surface coal gasification processes now under development and is about half the cost of gas from the existing Lurgi process. (auth)

31492 ENERGY CRISIS AND INTERNATIONAL POLICY. Sakisaka, M. (Japan Energy Economic Research Inst., Tokyo). At. Jap.; 17: No. 4, Suppl., 47-52(Apr 1973).

From 6th annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

Significance of the energy crisis in view of future prospect is first elucidated, then several uncertain factors in future oil supply are mentioned, and finally the necessity of international cooperation to cope with the difficulties is pointed out. The world energy consumption, centered in petroleum, is ever increasing because of population increase and rising living standard. In this situation, the utilization of nuclear energy plays an important role. The factors causing the uncertain supply of petroleum are the change taking place in supply mechanism, energy shortage in the U. S., possible international friction over the petroleum supply, and oil conservation policy taken by oil producing countries. To cope with the world problems of energy crisis, the international cooperation, one among oil consuming nations and the other between consuming and producing nations, is essential, in which full consideration must be given to those developing countries. (JA)

31493 PHYSICAL RESEARCH: A THREE-TIERED STRATEGY IN SUPPORT OF ENERGY R AND D. Zucker, A. Oak Ridge Nat. Lab. Rev.; 6: No. 3, 7-10(Fal 1973).

A three-tiered strategy in support of energy R & D is outlined that involves providing crucially needed data for nearly complete technologies; providing the expected but not at all certain discoveries needed for new technologies; and providing basic multifaceted research underpinning of the entire project. A two-phase model is cited of a near- and long-term model such as reducing the dependence on imported oil and gas by 1985 to 10 or 15% of total energy consumption, and a long-term goal to advance the energy base through a variety of technological developments after 1985. In the near-term, coal could be substituted for oil or gas in power generation plants and the development of coal liquefaction and gasification technologies need be advanced. The long-term strategy involves uranium or thorium breeder reactors, thermonuclear fusion reactors, geothermal energy, solar energy, energy strorage batteries, large-scale hydrogen production, and superconducting transmission lines. (MCW)

31494 INTRODUCTION TO THE ENERGY RESOURCES OF CALIFORNIA. Ritzius, D. E.; Rothermel, R. V. Sacramento, CA; California Division of Oil and Gas (1973). 66p.

Energy resources in California are discussed. Chapters are included on oil and gas origin and accumulation; oil and gas exploration methods; drilling methods; well completion and production methods; oil reservoirs; production stimulation methods; California's offshore fields; conservation; transportation of oil and gas; refining; history of production in California; environmental protection and enhancement; and geothermal resources. (MCW)

31495 HYDROCRACKING OF COAL IN MOLTEN ZINC IODIDE. Loth, R. A. (to Shell Oil Co.). US Patent 3,790,468. 5 Feb 1974. Filed date 16 Mar 1973. 6p.

Coal is continuously hydrocracked in suspension in a continuous-phase molten salt predominating in zinc iodide, at a temperature of from about 300 to about 500°C and under a pressure of from about 200 to about 3000 psg. The molten zinc iodide contains a substantial proportion of alkali metal iodide as a melting point depressant, sufficient to lower the melting point from about 446°C, the normal melting point of zinc iodide, to substantially below 350°C. The molten zinc iodide catalyst also contains ammonia, ammonium iodide, and water, in small proportions, resulting from hydrocracking the coal, all of which are also melting point depressants for zinc iodide. The slurry of coal in the molten catalyst system is prepared by first slurrying ground coal in at least 12 to about 25-fold proportions by weight molten iodide salt mixture predominating in zinc iodide and containing alkali metal iodide. The resulting slurry of coal in the molten salt mixture is then concentrated by separating a portion, at least one-third, of the molten salt mixture, to provide a still pumpable slurry of coal in molten salt, which is the charge to the hydrocracking zone. The separated excess molten salt is recycled to the primary slurrying operation to provide a portion of the molten salt for slurrying the coal. The molten salt mixture withdrawn from the hydrocracking operation is separated from volatile and normally liquid products of the reaction, and a major proportion thereof is recycled to the primary slurrying step. A minor proportion of the molten salt mixture is extracted with an aromatic solvent to remove resulting tar-like material and then filtered to remove solids, after which the separated molten salt is recycled to the primary slurrying operation. (auth)

31496 HYDROCRACKING COAL IN MOLTEN ZINC IODIDE. Loth, R. A.; Wald, M. M. (to Shell Oil Co.). US Patent 3,790,469. 5 Feb 1974. Filed date 16 Mar 1973. 6p.

Coal is slurried in a molten salt mixture predominating in zinc iodide and the coal is hydrocracked at a temperature of about 300 to 500°C and at a pressure of about 200 to 3000 psig in the presence of hydrogen. The molten salt mixture contains a substantial proportion of alkali or alkaline earth metal iodide as a melting point depressant, sufficient to lower the melting point from about 446°C, the normal melting point of zinc iodide, to substantially

below 350°C. The hydrocracking converts nitrogen and oxygen in the coal to ammonia and water, respectively, the ammonia being converted in part to ammonium iodide. The generated water, ammonia, and ammonium iodide all function as melting point depressants for zinc iodide. A major portion of the molten salt mixture, containing coal residue, including tar and ash, is recycled to the hydrocracking process. A minor proportion of the resulting molten salt mixture from hydrocracking is separated as a slip-stream and processed for recovery of the molten salt mixture thereof, and conversion of zinc sulfide and ammonium iodide formed hydrocracking the coal, to recover the zinc and iodide contents thereof as zinc iodide, which is also recycled to the coal slurry operation. (auth)

31497 POWER FROM COAL. III. Combustion Controls and Pollution Controls. Power; 119: No. 4, S49-S64(Apr 1974).

Economical and safe steam generation in industrial and utility plants demands precise and reliable control equipment. Boilers must have controls that will maintain steam pressure within ±1 to 2% of the design point, fuel/air ratio within ±5% of excess-air requirements over the entire load range, and steam-drum water level within ±1 in. of the desired height. Regulation of combustion, burner-management, and feedwater controls is required. Combustion and burner-management are discussed. Four equipment designs are discussed to curb stack dust emissions. Stack emissions from coal-fired boilers consist of particulates, oxides of nitrogen, and sulfur dioxide. Control of particulates and nitrogen oxides are discussed. The characteristics of the coal must first be known. (MCW)

31498 METHOD OF EXTRACTING HEAT FROM DRY GEOTHERMAL RESERVOIRS. Potter, R. M.; Robinson, E. S.; Smith, M. C. (to United States Atomic Energy Commission). US Patent 3,786,858. 22 Jan 1974. Filed Date 27 Mar 1972. 6p.

Hydraulic fracturing is used to interconnect two or more holes that penetrate a previously dry geothermal reservoir, and to produce within the reservoir a sufficiently large heat-transfer surface so that heat can be extracted from the reservoir at a usefully high rate by a fluid entering it through one hole and leaving it through another. Introduction of a fluid into the reservoir to remove heat from it and establishment of natural (unpumped) convective circulation through the reservoir to accomplish continuous heat removal are important and novel features of the method. (auth)

31499 IMPLICATIONS OF RECENT ORGANIZATION OF PETROLEUM EXPORTING COUNTRIES (OPEC) OIL PRICE INCREASES. Prepared at the Request of Henry M. Jackson, Chairman, Committee on Interior and Insular Affairs, United States Senate, Ninety-Third Congress, Second Session, Pursuant to S. Res. 45. A National Fuels and Energy Policy Study, Serial No. 93-35(92-71). Washington, DC; Committee on Interior and Insular Affairs (1974). 134p. GPO $1.25.

An overview of the OPEC oil price increases is discussed after a memorandum presented by Chairman Jackson. That governmental policy responses may be counterproductive is a view presented. A discussion on implications for global governmental policy formulation precedes eight tables presenting information on Persian Gulf crude oil prices; revenues from oil exports; oil revenue picture for 11 OPEC members; net trade balances, selected countries, 1972-73; selected countries: value of oil imports; total oil revenues available to producing governments and assumed potential use of funds, 1974; international financial liquidity, selected nations, 1971-73; and oil price rise impact for selected developing countries. Five papers are presented in the Appendixes on implications of exploding world oil costs; the economic consequences of the high cost of imported oil; oil and the world business cycle; energy shock and the development prospect; and the foreign-exchange market developments. (MCW)

31500 HIGHLIGHTS OF ENERGY LEGISLATION IN THE NINETY-THIRD CONGRESS, FIRST SESSION. A Background Paper Prepared by the Congressional Research Service at the Request of Henry M. Jackson, Chairman, Committee on Interior and Insular Affairs, United States Senate, Pursuant to S. Res. 45. A National Fuels and Energy Policy Study, Serial No. 93-38 (92-73). Washington, DC; Committee on Interior and Insular Affairs (1974). 120p. GPO $1.15.

A summary is presented of the congressional action taken on energy-related issues during the 93rd Congress, 1st Session. Legislation enacted included petroleum allocation; Alaska pipeline; daylight saving time; speed limit reduction; rural electrification; oil pollution; and EURATOM cooperation. Major energy legislation receiving House or Senate passage included energy research and development; energy conservation; conservation in federal facilities; Energy Research and Development Administration; Federal Energy Emergency Administration Act; energy emergency; Clean Air Act amendments; naval petroleum reserves; deepwater ports; Council on Energy Policy; strip mining; land use planning. Other energy measures involved Department of Energy and Natural Resources; Federal Oil Corporation; Energy Information Act; energy supply; power plant siting; and natural gas deregulation. Energy-related legislation receiving action and copies of bills enacted are included in appendices. (MCW)

31501 COAL LIQUEFACTION SOLIDS REMOVAL. Fiocco, R. J.; Wilson, E. L. (to Esso Research and Engineering Co.). US Patent 3,790,467. 5 Feb 1974. Filed Date 24 Apr 1972. 14p.

Solid residues are more effectively separated from a coal extract enriched solvent of a coal liquefaction product, in a solids-liquids separation zone in which solids size is a separation parameter, by adding to the coal liquefaction product a coal extract liquid derived from the coal liquefaction product and containing at least 20 volume percent of materials boiling below about 400° F or at least 20 volume percent of materials boiling above about 1000°F. (auth)

31502 INTERNATIONAL SYMPOSIUM ON ENERGY, MAN, AND THE ENVIRONMENT, ZURICH, SWITZERLAND, FEBRUARY 3–5, 1972. Zurich; Gottlieb Duttweiler Institute (1972). 193p. (CONF-720234-). 60 Swiss Francs.

Papers presented were: energy and man; energy and the hydrosphere; energy and business; present state and future development of traditional energy sources; energy trends in the United Kingdom; The ideological basis of planning; atomic energy—the future now?; energy and environmental protection: the dangers of nuclear power; atomic power and the environment: some problems encountered between design and construction; and the earth a dying planet? (MCW)

31503 UTILIZATION OF OIL SHALE: PROGRESS AND PROSPECTS. New York; United Nations (1967). 120p. $2.00.

The magnitude of known oil shale deposits is indicated by the fact that conservative estimates suggest that their potential in calories is equivalent to 18,000 times the present annual world consumption of energy. Oil shales have to date been used primarily as raw material for the production of liquid fuels. When oil shale is heated in retorts the organic matter (kerogen) yields a product called shale oil. It is commonly stated that practically any grade of petroleum can be produced from oil shales by appropriate eduction and cracking procedures. As a result of recent technical developments, oil shales may now also be used directly as fuel in thermal electric power plants and other boilers, and as raw material for large-scale production of town gas. In several cases the economics of the use of oil shales have been improved by the combined production of oil and a number of other products such as steam, electricity, ammonium sulfate, sulfur, chemicals, uranium, and cement. In some parts of the world, oil from the richer and more accessible oil shale is about to cross the threshold to economic competition with crude oil products, and oil shale used as fuel in thermal power stations has also begun to compete economically with solid or liquid fuel delivered at locations near the oil shale deposits. (MCW)

31504 PROGNOSIS FOR EXPANDED U. S. PRODUCTION OF CRUDE OIL. Berg, R. R.; Calhoun, J. C. Jr.; Whiting, R. L. (Texas A and M Univ., College Station). Science; 184: No. 4134, 331-336(19 Apr 1974).

It is estimated that less than one-half of the oil in place has been discovered in the U. S. and its territorial waters, and most new oil will come from Alaska and offshore. The drilling rate, the finding rate, and access to favorable petroleum provinces are the factors controlling the discovery of petroleum. Exploration needed for discovery and development of new reserves on the continental shelf will be expensive. A downtrend in drilling rate and finding rate has occurred for the last twenty years. Any technological breakthrough in exploration, drilling, production, or oil recovery; the discovery of a giant field; or substantial improvement in the economic incentives will reduce the gap between domestic crude oil production and demand. Commitment by government and industry to cooperate to solve the problem is necessary. (MCW)

31505 PROBLEMS OF EXPANDING COAL PRODUCTION. Walsh, J. Science; 184: No. 4134, 336-339(19 Apr 1974).

An increase in coal production and consumption is necessary if the U. S. is to gain energy self-sufficiency. The clearing of an array of environmental, technical, social, and economic factors is necessary to improve production records. Oil and natural gas replaced coal following World War II and there was much speculation that nuclear power was the long-term energy source, so a great lag developed in coal research. Electric power is produced overwhelmingly from coal combustion, and with the passage of the Clean Air Act of 1970, it appeared that standards for sulfur emission control could not be met by the 1974 deadline. Stack scrubbers are expensive and considered to be unreliable. Synthetic

fuels production from coal is expensive. Labor relations in expanding coal production is discussed. (MCW)

31506 CLEAN FUELS FROM COAL GASIFICATION. Squires, A. M. (City Coll., New York). Science; 184: No. 4134, 340-346 (19 Apr 1974).

The quickest path to synthetic fuels requires reviewing technologies now in use and finding engineering firms competent to reproduce and adapt these technologies with maximum effect. By gasifying coal with air, the engineer can produce power gas, a mixture of carbon monoxide and hydrogen with nitrogen. By gasifying with oxygen and steam, one obtains blue water gas or synthesis gas, a mixture of carbon monoxide and hydrogen. In existing plants, this gas is being converted to ammonia or methanol or, in South Africa, to synthetic gasoline. The advantages and disadvantages of the methods being investigated today are discussed. Development activities deserving high priority include Ignifluid, Koppers-Totzek, Babcock & Wilcox-duPont type of suspension gasifier, and gas cleaning. The quickest way to coal gasification is gasifying Pennsylvania anthracite and retrofitting an existing gas-fired boiler to burn power gas from a revamped Ignifluid. (32 references) (MCW)

31507 HIGH-SULFUR COAL FOR GENERATING ELECTRICITY. Dunham, J. T.; Rampacek, C.; Henrie, T. A. (Bureau of Mines, Washington, DC). Science; 184: No. 4134, 346-351(19 Apr 1974).

The use of high-sulfur coal from the Midwest and the Eastern U. S. is needed to help alleviate the shortages in energy production. U. S. pollution regulations on sulfur oxide emissions from power plants prohibit the use of this high-sulfur coal, but reliable flue gas desulfurization processes that permit burning of these coals without adverse environmental effects are approaching full development and should encourage wider use of coal in electricity generation for the next 25 years. The cost of flue gas desulfurization will be high, amounting to about a 3 to 6 percent increase, but may not be as high in comparison to dependence on foreign oil. (25 references) (MCW)

31508 NUCLEAR ELECTRIC POWER. Rose, D. J. (Massachusetts Inst. of Tech., Cambridge). Science; 184: No. 4134, 351-359(19 Apr 1974).

An assessment of nuclear power involves comparisons with fossil-fuel power plants. In the 21st century when fossil fuels are limited, nuclear power must be the power to generate electricity. Its benefits include lower production costs, vastly larger resources, and substantially less total adverse environmental impact compared with fossil fuels. Costs and hazards include not only the usual economic ones of the facilities themselves, but also those associated with illegal diversion of nuclear fuels, accidents, radioactive waste storage, and other environmental and societal impacts. (23 references) (MCW)

31509 ENERGY CHOICES THAT EUROPE FACES: A EUROPEAN VIEW OF ENERGY. Haefele, W. (International Inst. for Applied Systems Analysis, Laxenburg, Austria). Science; 184: No. 4234, 360-367(19 Apr 1974).

The demand and supply of primary energy has changed in Western Europe since the 1950's, at which time they became almost dependent on Middle East oil. Europe does not have the coal reserves that the U. S. possesses and cannot prepare to use coal. Nuclear power can in the short term only take care of that portion of primary energy which goes into the production of electricity. The energy plans of F. R. Germany to 1985 are discussed. Four options for the energy supply that comes after nonfossil fuel resources are given. These are nuclear fission in the fast breeder and other reactors, nuclear fusion, solar power, and harvesting of heat from the Earth crust. Europe has less time to the asymptotic phase (includes the options above) in the energy problem than the U. S., so an examination was made of secondary energy sources. An application of nuclear process heat is shown for transformation into chemical binding energy, namely, the transformation of methane and water into hydrogen and carbon monoxide. A diagram of the energy transmission system EVA + ADAM is shown. (MCW)

31510 TIMETABLE FOR EXPANDED ENERGY AVAILABILITY. Hammond, A. L. Science; 184: No. 4134, 367-369(19 Apr 1974).

Energy availability depends upon technical potential of a technology or a resource or whether the estimate also assumes favorable economic conditions and a new political consensus. Continued high prices for oil, coal and natural gas seem inevitable. Domestic production of all fossil fuel is lagging. The rush to lease offshore areas in the Gulf of Mexico continues. Drilling on the continental shelf is discussed. Coal and the establishment of a synthetic fuel industry based on coal is probably in national interest. The availability of nuclear, geothermal, and solar energy is cited. (MCW)

31511 SOCIAL SYSTEM AND THE ENERGY CRISIS. Boulding, K. E. (Univ. of Colorado, Boulder). Science; 184: No. 4134, 255-257(19 Apr 1974).

The view is presented that the economic and social system of the whole world will be changed due to the sudden termination of cheap and abundant oil and natural gas. The impact of a sharp rise in the price of energy on the whole relative price structure of different commodities has not been researched, but is now here. It is thought that more effort will be put into supply problems than into the demand adjustments or conservation. If a commodity is cheap now, but will be expensive later, there is something to be said for making it expensive now. There will be forced economizing of it. The embargo forced the higher price of oil, but it is better for it to be high now, and be experiencing the conservation being practiced, than to wait until 1990 when it might be too late to quickly advance technology to have energy at all. There is no bankruptcy in energy. Family-life changes, transportation changes, and food shortages loom from the energy shortages. Oil may be more important as a source of fertilizer than of gasoline. (MCW)

31512 EVOLUTION OF PUBLIC RESPONSE TO THE ENERGY CRISIS. Murray, J. R. (National Opinion Research Center, Chicago); Minor, M. J.; Bradburn, N. M.; Cotterman, R. F.; Frankel, M.; Pisarsi, A. E. Science; 184: No. 4134, 257-263(19 Apr 1974).

Results are presented from surveys conducted for the Department of Transportation and the Federal Energy Office on the impact of the energy crisis. The changes in behavior and attitudes of the public were measured since November 1973. Only 25% feel it is the most important problem facing the USA today, and it is felt that scores were determined by those who have experienced shortages of gasoline. Agreement is widespread that responsibility for the energy crisis lies on the federal government and the oil companies. There is little indication of any serious change in lifestyle, very little car pooling, and most believe that there will be plenty of gasoline in five years. The poll results are discussed for fuel oil and electricity. Rationing, increased prices, and local priorities were issues included on the surveys. (MCW)

31513 CONSERVATION IN INDUSTRY. Berg, C. A. (Federal Power Commission, Washington, DC). Science; 184: No. 4134, 264-270(19 Apr 1974).

The power of fuel price to promote efficient utilization is illustrated by some fuel conservation measures in industrial plants. Fixing broken windows and closing doors during loading are simple examples. Some technical measures cited are insulating water-cooled skid rails used to convey material through a heat-treating furnance, recapturing stack gas heat from a radiant fired tube and using it to preheat combustion air as a heat recuperator, installing heat pipe vacuum furnaces, and combining industrial production of process steam with electric power generation. Awareness of the conservation measure, loans for new equipment, and the risks in installing new equipment are discussed. The use of computer controls in the operation of processing plants is beneficial. (MCW)

31514 ENERGY CONSERVATION AT AN INDUSTRIAL RESEARCH CENTER. Brown, A. E.; Berkowitz, E. B. (Summit Technical Center, NJ). Science; 184: No. 4134, 271-272(19 Apr 1974).

The experience at the Celanese Summit Technical Center on energy conservation is described. Electrical involvement included reducing temperatures to 68°F; hall lights reduced by 50%; hot plates, ovens, heating mantles, and controlled temperature baths turned off when not in use; and lights in parking lot turned out in early evening and turned on again in morning darkness. The air handling system in the laboratories was readjusted, but still maintained health and safety. Car pools were negotiated. Commuters are now practicing energy conserving measures. Fuel oil savings from December through February, 1974 were about 30%, and electricity savings varied from 23 to 30%. (MCW)

31515 WHAT CAN THE ACADEMIC COMMUNITY DO? Metz, W. D. Science; 184: No. 4134, 273-278(19 Apr 1974).

Staff shortages are beginning to affect research and development efforts related to energy. People will have to be found in other industries or new graduates will have to learn as they go. Mining engineers and geologists are especially in short supply. Engineers are needed to solve environmental, health, materials, and food problems. Research plans of the NSF, EPA, Department of the Interior, and the AEC are outlined and it is estimated that the academic share of energy studies will be $180 million for the coming fiscal year. (MCW)

31516 INDIVIDUAL SELF-SUFFICIENCY IN ENERGY. Hammond, A. L. Science; 184: No. 4134, 278-283(19 Apr 1974).

Individual lifestyles, food, housing, and transportation are examined for self-sufficiency in energy. The search for alternative lifestyles that began in the 1960's developed a market for wind-

mills, solar-heated houses, methane digestors, household composters, electric cars, energy-saving cookware, wood stoves, solar collectors, and a renewed market for bicycles, and long underwear. Many homes have been constructed and are being heated with solar energy. Electric power is generated from windmills to run small appliances and lighting. A home is described where solar heating is applied and both photovoltaic and windmill power generators will furnish power, as well as conventional oil and utility connections for backup. Other features include two built-in greenhouses and wastes composted with a Swedish clivus system. (MCW)

31517 MULTIPLE FAILURES OF PUBLIC AND PRIVATE INSTITUTIONS. Sporn, P. Science; 184: No. 4134, 284-286 (19 Apr 1974).

The view is presented that Congress failed in not establishing a national energy policy long ago. The failures of the executive branch, The Department of the Interior, The Federal Power Commission, The Securities and Exchange Commission, and state regulatory commissions are discussed. In the private sector, the failures of the electric and gas utilities, the oil and coal industries, automobile manufacturers, and the environmental movement are enumerated. The causes of the crisis are pointed out and summing up there is not usable instrumentality for reviewing and appraising the quality of planning, building, and operating to assure an adequate, reliable supply of energy in the various forms required to serve the nation. Solutions, including the necessity for new institutional structures, are given. (MCW)

31518 [INTERVIEW ON ENERGY POLICY]. Executive: William E. Simon. Science; 184: No. 4134, 287-290(19 Apr 1974).

A transcript of a March 21, 1974 interview is presented with William E. Simon on the progress he has made as head of the Federal Energy Office to fashion emergency fuel allocation and conservation programs that would get the country through the winter and to begin to develop a long-term policy that would ensure U. S. energy self-sufficiency to meet new world conditions. (MCW)

31519 [INTERVIEW ON ENERGY POLICY]. Congress: Sen. Henry M. Jackson. Science; 184: No. 4134, 291-294(19 Apr 1974).

A transcript of a March 29, 1974 interview is presented with Sen. Henry M. Jackson. In the early 1960's, Sen. Jackson was supporting the preservation of the California redwoods, preservation of the wilderness, pollution abatement, and environmental law. In the late 1960's, he correctly anticipated that energy policy would become a major national issue. He is the author of the National Environmental Policy Act. His philosophy on energy is given and relates to three main areas of development. (MCW)

31520 INTEGRATED NATIONAL ENERGY RESEARCH AND DEVELOPMENT PROGRAM. Auer, P. L. (Cornell Univ., Ithaca, NY). Science; 184: No. 4134, 295-301(19 Apr 1974).

The basic problem in the energy crisis is to balance energy supply and demand in such a way that various economic, international, environmental, and societal factors are taken into consideration even though there are conflicts among them. The structure and aims of scientific R&D programs should reflect the goals and objectives of stated policy, yet have the flexibility to accommodate evolutionary changes in policy. Project Independence is expected to bring the federal government to embark on a serious attempt to balance supply and demand, such that reliance on imports can be reduced. The view is presented that the goals of the federal programs must be to restrain the growth of energy demand and expand domestic energy supply subject to the usual constraints of economic health, environmental care, and societal acceptance and must be accomplished in a way that will foster improved international relations. Prospects for all energy sources are discussed. (MCW)

31521 FLORIDA: AN ENERGY POLICY EMERGES IN A GROWTH STATE. Carter, L. J. Science; 184: No. 4134, 302-305(19 Apr 1974).

Florida's consumption of electricity has been increasing at an annual rate of 11%, as opposed to 7% for the nation. Air conditioning in residences and tourist accommodations and the great increase in population with the migration of 6000 people to the state each week, have resulted in the formulation of new energy policies. Gross energy consumption per capita is lower, but energy consumption for transportation per capita is 5% higher than the national average. The establishment of an energy policy committee was formed in the spring, 1973. Environmental land and water management laws were enacted in 1972 following the threat posed by the onrush of development to Florida's delicate hydrologic and ecologic systems pointed out by a severe drought. The recommendations for curbing the rising demand for energy, especially in those regions under increasing environmental stresses, are described. (MCW)

31522 ENERGY USE IN THE U. S. FOOD SYSTEM. Steinhart, J. S. (Univ. of Wisconsin, Madison); Steinhart, C. E. Science; 184: No. 4134, 307-316(19 Apr 1974).

An investigation into the growth of energy use in the food system is presented. An attempt is made to compare the present food supply system, in energy measures, with those of other societies and with the U. S. past. The energy provided by the sun is omitted in the survey, but the other factors considered are fuel (direct use), electricity, fertilizer, agricultural steel, farm machinery, tractors, irrigation, food processing industry and machinery, paper packaging, glass containers, steel cans and aluminum, transport (fuel), trucks and trailers, commercial refrigeration and cooking, refrigeration machinery (home and Commercial), home refrigeration and cooking. Private delivery by the individual is not included. Energy subsidies for various food crops are shown in various countries and compared with the U. S. food system. In primitive cultures, 5 to 50 food calories were obtained for each calorie of energy invested. Industrialized food systems require 5 to 10 calories to obtain 1 food calorie. An analysis of the energy flow in the food system illustrates features of the food system unrealized in a usual economic analysis. (32 references) (MCW)

31523 ECONOMIC STRATEGY FOR IMPORT–EXPORT CONTROLS ON ENERGY MATERIALS. Frank, H. J. (Univ. of Arizona, Tucson). Science; 184: No. 4134, 316-321(19 Apr 1974).

Five policy elements should be combined in assuring adequate energy supplies at acceptable costs: moving toward a more balanced distribution of power between producing and consuming countries; developing a technological readiness for national energy independence; establishing desirable stocks and reserve productive capacity; relying on a flexible tariff system for linking domestic and world energy markets; and adopting an export strategy that supports the basic objective. Two conditions are sine qua non's to any import–export strategy regarding energy materials. Policies must be clearly laid out and pursued with a steady hand in order that investors can afford to commit the vast sums necessary and expect recovery and adequate returns, typically spread over long periods of time. The policy package must be internally consistent, avoiding the conflicts and contradictions that so often have marred U. S. energy policy in the past. (auth)

31524 OIL MONEY AND WORLD MONEY: CONFLICT OR CONFLUENCE. Stauffer, T. R. (Harvard Univ., Cambridge, MA). Science; 184: No. 4134, 321-325(19 Apr 1974).

An attempt is made to analyze the impact of escalating oil prices upon the international money markets and the balance of payments positions of the major powers. It is unknown what effect the quadrupled export prices will have throughout the international economy. The bounds of the problem and illustrations of several issues are discussed covering the parameters of the oil price increase; the prior role of middle eastern oil in the international balance of payments; the contribution of oil price increases to inflation; the impact of price increases upon trade balances; their implications for financial markets; and interpretations and tentative conclusions. (MCW)

31525 APPLICATIONS OF INPUT–OUTPUT ANALYSIS TO ENERGY PROBLEMS. Carter, A. P. (Brandeis Univ., Waltham, MA). Science; 184: No. 4134, 325-329(19 Apr 1974).

A brief outline of the U. S. input–output system and data base is given. An input–output table gives a detailed picture of the flow of goods and services that individual industries buy from and sell to each other in a particular year. The system was used in estimating the impact of 1973–1974 petroleum shortages on output, employment, and prices. The system was also used to analyze the long-term economic effects of prospective changes in energy technology. A comprehensive study is Wassily Leontief's worldwide model. Its scope includes agriculture and other resources and will include input–output tables of 40 sectors for 15 regions of the world. (MCW)

31526 METALLIC HYDROGEN STORAGE MATERIAL: HIGH COMPRESSION AND SAFE STORAGE OF THE GAS POSSIBLE. VDI (Ver. Deut. Ing.) Nachr.; 27: No. 44, 15(Oct 1973). (In German).

One of the recent important achievements of the research work carried out in the Philips laboratories is the discovery of metallic hydrogen storage devices. The metallic storage material is described by the formula AB_5H_x, with A standing for rare earth, B for either cobalt or nickel, and H for hydrogen. Hydrogen being added to $LaNi_5$, e.g., will result in the formation of the hydride $LaNi_5H_6$, with six H atoms being bound to one unity, whereas in $SmCo_5$, 2.5 H atoms are added to the compound. (GE)

31527 ALABAMA TAR SANDS PROJECT, 1972. Moftah, I.; Boone, P. A. Tuscaloosa, AL; University of Alabama (1973). 55p. $13.45.

A research study of tar sands in Colbert, Franklin, Lawrence, and Morgan counties in Alabama was carried out in 1972. Fieldwork included geologic mapping of the Hartselle Sandstone of Mississippian age and its oil impregnated intervals, sampling along the outcrop of the impregnated zones, and analysis to determine the porosity, permeability, and hydrocarbon saturation. Seven core holes were drilled downdip from the outcrop of the oil-impregnated sandstone and then analyzed. Hydrocarbon reserves were calculated from the analyses resulting in the conclusion that within an area of 32,000 acres there are about 150 million barrels of oil impregnated in the sandstone. Appendix A includes measured sections data; Appendix B includes Alabama tar sands core holes data; and Appendix C is the Shell Oil Company core holes data. Five maps or plates are locations of measured sections; oil saturation; total thickness of oil impregnated sand; possible oil reserves; and a generalized geologic map of Morgan County and parts of Lawrence County. (MCW)

31528 CHEMICALLY MINING COAL. Elliott, G. R. B. (Los Alamos Scientific Lab., NM). Mining Eng. (N.Y.); vp(Sep 1973). (LA-DC-72-15026).

Some reactions with coal give off heat and others absorb heat. The reactions of coal with oxygen or air give off heat, but the reactions of coal with steam or with carbon dioxide absorb heat. By balancing the proportions of the two types of reactions, the energy of the coal can be almost completely recovered and environmental damage is minimized. The chemical reactions of solid coal + gaseous oxygen yields carbon dioxide. An in-depth table lists the thermodynamic values for reactions in coal processing beginning with the aforementioned reaction. Twelve reactions are tabulated. Areas of the Southern Rockies overlying coal fields are shown. Political pressures are heavy against stack emissions from coal fires. The Four Corners coal-burning power plant is involved in expensive stack emission control. Underground gasification plus available cleanup procedures could eliminate the particulate problem and reduce the sulfur problem before the power plant burned the fuel. (MCW)

31529 POSSIBLE REDUCTION OF SERIES RESISTANCE OF A SILICON SOLAR CELL THROUGH USE OF A COMPOSITE BUILT-IN FIELD AND IMPROVED MATERIAL. Deb, S.; Saha, H. (Jadavpur Univ., Calcutta). Phys. Status Solidi (a); 22: No. 1, K49-K53(16 Mar 1974).

In order to obtain maximum benefit of concentrated solar radiation, the skin layer resistance must be reduced. One way is to use a thicker skin layer with means for compensating the adverse effect of recombination; this means is a composite built-in field of proper distribution in the skin region. The composite field comprises a narrow region close to the surface with a field acting toward the surface, and a wide region with a field acting toward the junction. Equations are derived, and it is shown that the efficiency may be doubled or more with a cell having a 15-μm skin layer, the net rise being 10 while total voltage drop ~0.04 V. The series resistance will be 0.10 of the value of a field-free cell. (DLC)

31530 REGULATORY ALTERNATIVES AND SUPPLY OF CLEAN FUELS. Reed, J. L. (Dept. of the Interior, Washington, DC). Chem. Eng. Progr.; 69: No. 11, 72-78(Nov 1973).

The option of whether to encourage domestic production of residual fuel oil or rely on imports, becomes an important issue involving refinery construction. The unique characteristics of residual fuel oil are discussed. Residual fuel oil production by a crude oil replacement program has been encouraged. The result of this program would be that new and expanded refineries would obtain a more balanced refinery configuration than present facilities that are concerned with producing light products. Increased domestic production of residual fuel oil would promote economic development, enhance national security, and benefit the environment. The effect on the petrochemical feedstocks arising from the drawback plan is analyzed. Other potential occurrences such as the manufacture of SNG from oil feedstocks are considered. (MCW)

31531 SULFUR DEVELOPMENTS: LOW B.T.U. GAS FOR POWER PLANTS. Conn, A. L. (Amoco Oil Co., Whiting, IN). Chem. Eng. Progr.; 69: No. 12, 56-61(Dec 1973).

Direct combustion of high-sulfur coal presents problems. An alternative is the production of low Btu gas from coal. Two advantages of this process are: that the gas is produced under reducing conditions, with the result that sulfur is converted to H_2S, which can readily be removed by well-proven absorption processes; and secondly, the gas can be generated under pressure, permitting some operating economies in an existing power plant, and more advanced power plant design for a new plant. Some disadvantages exist due to the fact that the operation resembles chemical plant operation with controls of flow and composition, etc. The Lurgi process is the only immediate commercial application, but the Texaco gasifier, Bamag-Winkler gasifier, Wellman-Galusha gasifier, B&W-DuPont gasifier, Westinghouse gasification process, Union Carbide gasification process, Bi-Gas process, and the Koppers-Totzek gasifier are discussed. (35 references) (MCW)

31532 COLD FLOW MIXING STUDY OF A VORTEX COAL GASIFIER. Strickland, L. D. Morgantown, WV; West Virginia Univ. (1973). 213p. University Microfilms Order No. 74-227.

Thesis (Ph. D.).

A cold flow model of a vortex coal gasifier was fabricated and evaluated experimentally to determine the geometric and fluid dynamic variables controlling the mixing between a vortex combustion stream and a separate, through flowing core gasification stream. The aluminum and transparent acrylic model incorporated a transparent outer body for flow visualization, an adjustable conical vortex exhaust valve, provisions for changing the inlet and outlet core tube diameters, and provisions for changing the core gap length. A smoke flow visualization test program and a quantitative gas mixing study employing a carbon dioxide vortex and an air core were conducted. Visual and quantitative data are presented to show the effects of important variables for counter-flowing and coflowing streams. Core mass retention and core exhaust purity are treated as the important data results. These results were found to depend primarily on the vortex inlet Reynolds number, a parameter related to the ratio of the vortex inlet Reynolds number to the core inlet Reynolds number, the core gap, and the core inlet tube diameter. A summary of the visual results illustrating the important effects is presented along with polynomial curve fits of the core mass retention data. Complete tabulations of the measured and calculated gas mixing data are also included. (Diss. Abstr. Int., B)

31533 CONTINUOUS STEAM GASIFICATION OF COAL CHAR IN AN ELECTROFLUID REACTOR. Beeson, J. L. Ames, IA; Iowa State Univ. (1973). 411p. University Microfilms Order No. 74-520.

Thesis (Ph. D.).

An experimental investigation was made in which an electrofluid reactor for the steam gasification of coal char which was operated at atmospheric pressure over a temperature range of from 1500 to 1900°F. Both a single-phase and a three-phase alternating-current power supply were used to operate the reactor. Since the gasification of coal char is not a proven application of the electrofluid reactor, one of the purposes of the investigation was to explore the operation of such a reactor over long time periods to simulate the operation required of commercial units. A second purpose of the investigation was to obtain design information for electrofluid reactors. Calculation studies were made with published data in addition to the experimental work done with the reactor. Off-gas composition as a function of steam conversion was studied using a model which assumed the water gas shift and methanation reactions to be at equilibrium. Agreement of experimental data with the model was approximate at 1700°F, and the agreement improved with increase in temperature. An overall plug flow model was used to calculate inverse space velocity as a function of steam conversion; the fluidization effects were accounted for by using kinetic constants determined for fluidized bed reactors. The calculated steam conversions were in approximate agreement with the model at 1700°F; further, it was found that the reactivity of the coal char changed during the gasification, exerting a perceptible effect on the observed steam conversion. (MCW)

31534 GEOTHERMAL ENERGY. Hearings Before the Subcommittee on Energy of the Committee on Science and Astronautics, United States House of Representatives, Ninety-Third Congress, First Session on H. R. 8628, H. R. 9658, September 11, 13, and 18, 1973. Washington, DC; Committee on Science and Astronautics (1973). 386p. GPO.

Legislation was presented to further energy research and development by establishing a Geothermal Energy Development Corporation: to amend the National Science Foundation Act of 1950; and authorize and direct the National Science Foundation to fund basic and applied research related to energy and thereby support the objectives of the corporation. The hearings involved information and alternative strategies for action relevant to the geothermal resources base, state of geothermal energy technology, economic feasibility of exploitation, environmental problems, and research and development needs. To date, geothermal energy has made only local contributions to the energy supply, but with the exploitation of hot dry rock formations dispersed beneath the Earth's surface, the contribution to the world's energy supply could be significant. (MCW)

31535 COAL LIQUEFACTION PROCESS. Urban, P. (to Universal Oil Products Co.). US Patent 3,796,650. 12 Mar 1974. Filed date 24 Jul 1972. 10p.

A process is disclosed for de-ashing and liquefying coal that comprises contacting comminuted coal with water, at least a portion of which is in the liquid phase, a reducing gas and a compound selected from ammonia and carbonates and hydroxides of alkali metals, at liquefaction conditions, including a temperature of 200 to 70°C. to provide a hydrocarbonaceous product. (Official Gazette)

31536 NEW PIPELINE STEEL FOR LOW-TEMPERATURE USES. Mihelich, J. L. (Climax Molybdenum Co., Pittsburgh); Smith, J. H. Metal Progr.; 105: No. 4, 39-41(Apr 1974).

A natural gas pipeline 42-in. in diameter with a composition of 0.05 C, 1.60 Mn, 0.05 Si, 0.25 Mo, and 0.06 Nb is now in operation for 240 miles in central Canada. The steel meets the requirements of subzero arctic conditions and features high strength, exceptional toughness, and weldability. Specifications were for a minimum yield of 65,000 psi and tensile strength of 80,000 psi, with a minimum of 35 percent shear fracture and a minimum all-heat average of 75 percent shear fracture at 25 F transverse to the pipe axis, as determined by the Battelle Drop Weight Tear Test. The new steel may also be used in the automotive, railway, heavy equipment, construction, and ship building industries. (MCW)

31537 GEOTHERMAL ELECTRICITY PRODUCTION. Robson, G. R. (United Nations, New York). Science; 184: No. 4134, 371-375(19 Apr 1974).

An evaluation is attempted of the institutional and economic facts that take part in determining the future scale of geothermal development in the short-term. Three dry steam geothermal fields exist and are operable in Italy, the U. S., and Japan. These are the only ones and appear to be less common. It will be unfortunate if explorations prove no more dry steam reserves since in economic terms the operation is simple. Hot water or wet steam fields developed for electric power production are operating at Wairakei field and Kawerau, New Zealand; Otake, Japan; Pauzhetska and Paratunka in the Soviet Union; Namafjall, Iceland; and Cerro Prieto, Mexico. The production and economic factors of these developments are discussed. (MCW)

31538 SOLAR ENERGY BY PHOTOSYNTHESIS. Calvin, M. (Univ. of California, Berkeley). Science; 184: No. 4134, 375-381 (19 Apr 1974).

Photosynthesis, both natural and as a model process, was examined for its potential as a possible annually renewable resource for both material and energy. The conversion of carbohydrate from cane, beets, and other sources through fermentation alcohol to hydrocarbon may soon again become economic in the light of increasing costs of recovery of hydrocarbon from fossil sources and improved fermentation technology. Even the direct photosynthetic production of hydrocarbon from known sources (for example, Hevea) or newly bred ones seems possible. Finally, more distantly, synthetic systems constructed on the basis of growing knowledge of the photosynthetic processes, may produce both fuel and power. (29 references) (auth)

31539 SOLAR ENERGY UTILIZATION BY PHYSICAL METHODS. Wolf, M. (Univ. of Pennsylvania, Philadelphia). Science; 184: No. 4134, 382-386(19 Apr 1974).

Solar energy can be utilized by indirect methods using meteorological or geophysical effects; utilization of biological effects, direct use for heating; and conversion to electricity. Technical feasibility has been proven so that the work remaining to be done extends to proving or achieving economic feasibility and to applications. The question then becomes one of time scale that involves the short range with prime emphasis on overcoming ecological and social problems and on local or temporary energy supply shortages (up to 1980); the medium range, characterized by increasing general shortages of natural gas and petroleum (up to 2000); and the long range in which these two sources will be essentially exhausted, and if consumption should have increased as predicted, concern about large-scale thermal pollution may start to mount. (MCW)

31540 LOW-COST, ABUNDANT ENERGY: PARADISE LOST? Landsberg, H. H. (Resources for the Future, Inc., Washington, DC). Science; 184: No. 4134, 247-253(19 Apr 1974).

Low-cost energy has been an integral part of American economic history, but is gone for the present. The European experience has shown that with not much lower levels of per capita income, much lower per capita energy consumption is possible. The present situation with tight supplies and rising prices did not begin with the Arab embargo. A history is followed of the situations that lead up to the 1973 oil embargo. New techniques for the future include oil extractions from bituminous sands and shale, nuclear reactors, harnessing of geothermal and solar energy, and clean burning from coal. Environmental concerns and import independency are discussed. (MCW)

31541 STATE OF ATOMIC-ENERGY DEVELOPMENT AND UTILIZATION IN FISCAL 1971. Genshiryoku Iinkai Geppo; 17: No. 10, 24-44(Oct 1972). (In Japanese).

The results of survey on Japan's atomic-energy development and utilization carried out by the Science and Technology Agency are presented for the fiscal year 1971. Of the total 2670 (including the enterprises permitted by the laws of radiation-injury prevention and regulation of reactors, etc., and research institutions), 2253 answered the questionnaire. Remarkable increase was seen in personnel, facility investment, and research and development expenditures. The personnel engaged in atomic power business increased by 18% from the previous year. The total development expenditure, including personnel training, was 83,400 million yen, 50% higher than the previous year. The aggregate facility investment was 156,000 million yen, 57% increase. The total production was 32,300 million yen, 41% higher than in the preceding year. (JA)

Information Handling

Refer also to abstract 29401.

31542 (EUR-5079) MANAGEMENT OF BIBLIOGRAPHICAL DATA BY MEANS OF A SMALL COMPUTER. Tasman, H. A. (Commission of the European Communities, Karlsruhe (F. R. Germany). European Inst. for Transuranium Elements). Jan 1974. 13p. Dep. NTIS (U. S. Sales Only) $4.00. EUR B.Fr.40.

A series of computer programs have been written to assist in the establishing, updating, and exploitation of bibliographical files, by means of a small, low-cost computer (IBM-1130). The present version is specially adapted to a bibliography on heat transfer and related phenomena in nuclear fuels, but it could be relatively easily adapted to other applications. The minimum computer configuration is an IBM-1130 with 8 K core memory, one disc drive, a 1442/6 card reader/punch, and a 1132 line printer. To each entry, a keyword is attributed, composed of subject keys and material codes, which is based on the original text. The following information is stored: author names, a value code, the bibliographical reference, and the keyword. (auth)

31543 (TID-4045) INDEX TO CONFERENCES ASSIGNED CONF- NUMBERS BY THE TECHNICAL INFORMATION CENTER, U. S. ATOMIC ENERGY COMMISSION. Hardin, N. E.; McGinnis, D. H. (eds.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 589p. Dep. NTIS $13.60.

The document includes nuclear science related conferences which have been assigned CONF- numbers by the U. S. Atomic Energy Commission's Technical Information Center (TIC). It includes meetings, symposia, conferences, and congresses assigned a number in the CONF- report number series from 1962 through Fall 1973. Initially the CONF- number was a simple accession number. In 1965 it was converted to a six or seven digit code with the first two digits representing the year in which the conference was held, the next two representing the month, and the last two or, occasionally, three being an accession number. This document does not replace TID-4043(Rev. 3) or TID-4044 since information on relevant conferences not assigned a CONF- number is not included. The document contains two listings: The first is a computer-produced KWIC (Key-Word-In-Context) index of the conference location and title. Location information includes city, state or comparable political unit, and country. Title information is that used in the Nuclear Science Abstracts (NSA) Report Number Index. The second listing, also produced by computer, is numerically arranged by CONF- number and provides location, date, and title information for each conference. Both listings are unedited working copies. Availability information for all entries can be found by checking the NSA Report Number Indexes or by communicating with the Publications Request Section, TIC. (auth)

Law

Refer also to abstracts 29210, 29312, 29386, 29768–29777, 29854–29858, 29868, 29869, 31060, 31062, 31063, 31361, 31362, 31371, 31372, 31576, 31577, and 31620.

31544 (FDA-73-8029, pp 579-587) OPERATORS OF MEDICAL X-RAY MACHINES AND LEGISLATION: A REPORT ON THE CALIFORNIA PROGRAM. Schaeflein, J. W. (Univ. of Southern California, Los Angeles). Mar 1973.

In health physics in the healing arts.

The effort to establish minimum standards of education and training for operators of medical x-ray machines in the USA is discussed. (CH)

31545 TO ESTABLISH AN ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION AND A NUCLEAR ENERGY COMMIS-

SION. Hearings Before the Subcommittee on Reorganization, Research, and International Organizations on the Committee on Government Operations, United States Senate, Ninety-Third Congress, First Session, on S. 2744, December 4, 5, and 10, 1973. Washington, DC; Committee on Government Operations (1974). 651p. GPO $4.45.

A series of studies was carried out under the guidance of the Energy Policy Office in conjunction with government departments and agencies having energy responsibilities. People from industry, foundations, and the academic community were consulted, with other private citizens having responsibilities and acknowledged expertise in the energy field. The scope of the energy research and development report included the role of energy in our society; the relationship of energy research and development to energy policy; the distinction between energy research and development and energy production; the impact of research and development and other energy policy actions on the future of the nation's energy system; the necessity to support energy development with an expansion of environmental effects research, basic research, and manpower development; and the consequences of energy policies aimed at attaining other goals, such as economic growth, consumer protection, and land use. (MCW)

31546 ENERGY EMERGENCY LEGISLATION. Part 2. Executive Markup Session and Appendix Before the Committee on Interior and Insular Affairs, United States Senate, Ninety-Third Congress, First Session. A National Fuels and Energy Policy Study on S. 2589, November 9 and 12, 1973. Washington, DC; Committee on Interior and Insular Affairs (1973). 365p. GPO $2.65.

A markup session is presented on the bill to declare by congressional action a national energy emergency; to authorize the President to immediately undertake specific actions to conserve scarce fuels and increase supply; to initiate the development of local, state, national, and international contingency plans; to assure the continuation of vital public services; and for other purposes. The bill may be cited as the National Emergency Petroleum Act of 1973. Additional statements and communications are submitted for the record by personnel from industry and other organizations with interest in energy. (MCW)

31547 REPORT OF THE COMMITTEE ON LAW APPLICABLE TO NUCLEAR AND OTHER EXTRAORDINARY SOURCES OF ENERGY. Baker, R. M. Forum (Chicago); 9: No. 3, Special Issue, 403-405(1973).

A brief report is presented of activities during 1973. The committee considered future activities concerning radioactive waste management, civil liability in the field of nuclear energy, radiation protection standards, and environmental impact of nuclear installations. (SFL)

31548 NEW X RAY DECREE. Schulze, H. G. PTB Mitt.; 83: No. 5, 341-343(Oct 1973). (In German).

A brief outline of the most essential points that have been modified is presented. (GE)

31549 PRINCIPAL FEATURES, DEVELOPMENT, AND THE RESULTS OF THE ATOMIC ENERGY LAW. Pelzer, N. Wirtschaftsrecht; No. 2, 230-254(1972). (In German).

The Atomic Energy Law of the FRG becomes effective on January 1, 1960. In its essential features it is at present as before, in spite of some changes. A summary is given of the legal development of this statutory special regulation for a new branch of science, industry and economy. An attempt is made to strike a balance. In its essential parts this balance is a positive one. The radiation protection ordinance is not considered in this review. (GE)

31550 LICENSURE OF RADIOBIOASSAY LABORATORIES. Regnier, J. E.; Moghissi, A. A.; Moore, R. T. (Southeastern Radiological Health Lab., Montgomery, AL). pp 1817-1823 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

In December 1967, Congress passed the Clinical Laboratories Improvement Act of 1967, which provides for the licensure of any laboratory involved in the analysis of specimens taken from the human body which are transported in interstate commerce. These laboratories which perform analyses of body media for radionuclides (radiobioassay) are included within the jurisdiction of this law. This paper describes the law and the rationale used in the development of regulations that will govern the licensure of such laboratories. Particular emphasis is placed on the proficiency testing portion of these regulations and its potential significance and importance to the general field of personnel monitoring for radionuclide body burden evaluations. (auth)

Management

Refer also to abstracts 29210, 29312, 29314, 29386, 29713, 29769–29777, 29783, 29854–29858, 29868, 29869, 31371, 31372, 31374, 31544, and 31550.

31551 (FDA-74-8020) DENTAL RADIOLOGY TEACHER'S MANUAL. Wuehrmann, A. H.; Greer, D. F.; Alcox, W. (Alabama Univ., Birmingham (USA)). Feb 1974. Contract FDA 72-45. 253p. GPO.

Objectives of the manual, lesson formats, reference materials, and teaching aids are discussed in the introduction. Eight sections of the manual discuss physical principles of x radiation, radiobiological concepts related to dentistry, radiographic technique, principles of radiological health, x-ray films and intensifying screens, factors influencing radiographic film quality, darkroom equipment, and film mounting and interpretation. Appendices are given for course outline, laboratory exercises, American Academy of Dental Radiology guidelines, references, facilities, and audiovisual training aids. (HLW)

31552 (FDA-73-8029, pp 271-276) RADIATION AND HEALTH PHYSICS IN DIAGNOSTIC RADIOLOGY AND RADIATION THERAPY TECHNOLOGY TRAINING. Hendee, W. R.; Chaney, E. L.; Miller, D. A.; Bontrager, K. L.; Cuklanz, E. J.; Stevens, R. D.; Carson, P. L. (Univ. of Colorado Medical Center, Denver). Mar 1973.

In health physics in the healing arts.

31553 (FDA-73-8029, pp 277-280) SHORT TERM AND TWO-YEAR RADIOLOGICAL INSTITUTE AT MANHATTAN COLLEGE. Malsky, S. J.; Amato, C. G.; Crowe, G. J.; Hayt, D.; Blatt, C.; Simon, D.; Reid, C.; Gregory, W.; King, A. (Manhattan College, Bronx, NY). Mar 1973.

In health physics in the healing arts.

31554 (FDA-73-8029, pp 281-287) HEALTH PHYSICS TRAINING COURSES AT OAK RIDGE ASSOCIATED UNIVERSITIES. Akers, L. K.; Beck, W. L.; Cloutier, R. J.; Dickson, H. W. (Oak Ridge Associated Universities, TN). Mar 1973.

In health physics in the healing arts.

31555 (FDA-73-8029, pp 288-298) RADIATION PROTECTION PROGRAM FOR NURSING PERSONNEL. Ovadia, J.; Rossi, R. P. (Michael Reese Hospital and Medical Center, Chicago). Mar 1973.

In health physics in the healing arts.

31556 (FDA-73-8029, pp 299-301) HEALTH PHYSICS COURSE FOR STUDENTS IN HEALTH RELATED AREAS. Braundmeier, A. J. Jr. (Southern Illinois Univ., Edwardsville). Mar 1973.

In health physics in the healing arts.

31557 (FDA-73-8029, pp 302-306) BASIC INSTRUCTION IN RADIATION PROTECTION FOR UNIVERSITY PERSONNEL. Scheele, R. V.; Wakley, J.; Berk, H. W. (Univ. of Virginia, Charlottesville). Mar 1973.

In health physics in the healing arts.

31558 (FDA-73-8029, pp 313-319) DEGREE ASSOCIATED TRAINING PROGRAMS IN NUCLEAR MEDICINE PHYSICS AND TECHNOLOGY. Kereiakes, J. G.; Simmons, G. H.; Anger, R. R.; Branson, B.; Van Tuinen, R. (General Hospital, Cincinnati). Mar 1973.

In health physics in the healing arts.

31559 (FDA-73-8029, pp 320-326) TWENTY YEARS OF EXPERIENCE IN GRADUATE RADIATION SCIENCE EDUCATION BY THE HEALTH PHYSICS DEPARTMENT OF THE LAWRENCE BERKELEY LABORATORY AND THE BIOPHYSICS GROUP OF THE UNIVERSITY OF CALIFORNIA, BERKELEY. Wallace, R. (Univ. of California, Berkeley). Mar 1973.

In health physics in the healing arts.

31560 (FDA-73-8029, pp 327-332) TWELVE-MONTH M. S. PROGRAM IN RADIOLOGICAL HEALTH: 4 YEARS OF EXPERIENCE. Paraskevoudakis, P. (Puerto Rico Nuclear Center, Mayaguez). Mar 1973.

In health physics in the healing arts.

31561 (FDA-73-8029, pp 333-336) UNDERGRADUATE DEGREE IN RADIOLOGICAL HEALTH. Greenwood, R. A.; (Duquesne Univ., Pittsburgh, PA) Borke, M. L.; Brodsky, A. Mar 1973.

In health physics in the healing arts.

31562 (FDA-73-8029, pp 337-341) LABORATORY EXERCISES FOR TRAINING IN RADIOLOGICAL SCIENCES. Kavanaugh, H. V.; Mauderli, W.; Fitzgerald, L. T. (Ochsner Clinic, New Orleans, LA). Mar 1973.

In health physics in the healing arts.

31563 (FDA-73-8029, pp 342-346) NUCLEAR TECHNOLOGY AT THE CHATTANOOGA STATE TECHNICAL INSTITUTE: A. S.

DEGREE PROGRAM. Boyett, R. H. (Chattanooga State Tech. Inst., TN). Mar 1973.

In health physics in the healing arts.

31564 (FDA-73-8029, pp 347-350) COMPUTER ASSISTED INSTRUCTION IN RADIOLOGIC TECHNOLOGY TRAINING PROGRAMS. Chaney, E. L.; Stevens, R. D.; Frank, M. N.; Ibbott, G. S.; Hendee, W. R. (Univ. of Colorado Medical Center, Denver). Mar 1973.

In health physics in the healing arts.

31565 (FDA-73-8029, pp 351-357) TWO-PLUS-TWO RADIATION TECHNOLOGY TRAINING PROGRAM: EIGHT YEARS OF EXPERIENCE. Eger, K. J.; Everett, R. J.; Morris, M. (Oklahoma State Univ., Stillwater). Mar 1973.

In health physics in the healing arts.

31566 (FDA-73-8029, pp 358) X-RAY TECHNOLOGIST TRAINING IN RADIATION SAFETY. Hagen, N. S. (Harbor General Hospital, Torrance, CA). Mar 1973.

In health physics in the healing arts.

31567 (FDA-73-8029, pp 359-361) DEVELOPMENT OF RADIATION THERAPY TECHNOLOGY PROGRAM. Doppke, K. P.; Lane, R. G.; Tolbert, D. D. (Univ. of Wisconsin Hospitals, Madison). Mar 1973.

In health physics in the healing arts.

31568 (FDA-73-8029, pp 362) PHYSICS IN A 2-YEAR X-RAY TECHNICIAN TRAINING PROGRAM. Rossi, R. P.; Ovadia, J. (Michael Reese Hospital and Medical Center, Chicago). Mar 1973.

In health physics in the healing arts.

31569 (FDA-73-8029, 363-365) RADIOLOGICAL PHYSICS TEACHING PROGRAM IN A LARGE MEDICAL CENTER. Thompson, D. L.; Vacirca, S. J. (State Univ. of New York, Brooklyn). Mar 1973.

In health physics in the healing arts.

31570 (FDA-73-8029, pp 456-458) RADIATION PROTECTION IN RURAL HOSPITALS: IMMEDIATE HELP NEEDED. Waite, D. A. (Battelle Pacific Northwest Labs., Richland, WA). Mar 1973.

In health physics in the healing arts.

31571 (FDA-73-8029, pp 501) ADMINISTRATIVE RATIONALE FOR EMERGENCY SITUATIONS. Corbit, C. D. (Douglas United Nuclear, Inc., Richland, WA). Mar 1973.

In health physics in the healing arts.

31572 (FDA-73-8029, pp 517-520) HOSPITAL PLAN FOR EMERGENCY HANDLING OF RADIATION ACCIDENT CASES. Roessler, C. E.; Price, D. G.; Spencer, D. S. (Univ. of Florida, Gainesville). Mar 1973.

In health physics in the healing arts.

The plan adopted by the University of Florida's Shands Teaching Hospital and Clinics for coping with irradiated and/or contaminated patients in the event of radiation accidents utilizes an existing trauma room in the hospital emergency room. Under the plan, contamination control is achieved by establishing contamination boundaries and restricting the patient and attending personnel to designated areas. Staffing of the plan utilizes emergency room personnel, radiation control personnel, and the radiology residents. (auth)

31573 (FDA-73-8029, pp 558-563) MEDICAL RADIATION EXPOSURES: SHOULD THEY BE RECORDED FOR RADIATION WORKERS? Eason, C. F.; Brooks, B. G. (USAEC, Washington, DC). Mar 1973.

In health physics in the healing arts.

31574 (NP-19971) CODE OF PRACTICE FOR THE DISPLAY OF SOURCES OF IONIZING RADIATIONS AT EXHIBITIONS. (National Radiological Protection Board, Harwell (UK)). Dec 1973. 11p. Dep. NTIS (U. S. Sales Only) $4.00. UK 18 pence.

The Code of Practice has been approved by the National Radiological Protection Board, in the United Kingdom. It was prepared first in 1961 and was revised to bring the administrative recommendations up to date; the revision was also made in the light of the current recommendations of the ICRP. The Code covers administrative procedures, general precautions for avoiding radiation hazards, general requirements for radioactive sources (and additional requirements for unsealed sources), and machines producing ionizing radiations. (UK)

31575 IAEA AND FINLAND IN INTERNATIONAL COOPERATION FOR DEVELOPMENT. Moilanen, P. (International Atomic Energy Agency, Vienna). Kem.-Kemi; 1: No. 1, 7-14(1974).

The activity and purpose of the IAEA are presented, especially emphasizing the work of the Agency for the development of the Third World in the form of the direct technical assistance. The Finnish participation in, and contribution to, the work is treated. (JPL)

31576 ORGANIZATION OF A SMALL-SCALE RADIATION SAFETY PROGRAM. Tolan, J. H. (Univ. of Missouri, Rolla). pp 321-327 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Steps in the training of a professional health physicist who has completed his academic education are discussed. A list of suggestions for a young health physicist considering a position is presented. The list includes determining the level of research expenditures for the past few years; determining growth of the graduate student body; and determining the size of the radiation safety program. A list of suggestions for managing the program is given for a radiation safety officer who has just accepted a position. (HLW)

31577 HEALTH PHYSICS PRACTICES IN STUDENT LABORATORY AND RESEARCH PROJECTS. McLellon, W. M. (Clemson Univ., SC). pp 329-338 of Health Physics Operational Monitoring. Vol. 1. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P1.

Student laboratory and research projects involving exposure to radioactive hazards must receive close attention because of the varying backgrounds, capabilities, and particularly the varying interests of the students. Procedures established obviously should insure safety of the student. It is considered though that improvement of the student's background knowledge to equip him for further development is of almost equal importance, whether he plans to actively enter the nuclear energy field or not. Attention to proper indoctrination should not be relaxed even if working at the lower end of the radiation hazard spectrum. Instead, education and training should always be aimed at a more severe and varied hazards condition, including accident in order to insure maximum development. (auth)

31578 HEALTH PHYSICS EDUCATION AND TRAINING: PAST, PRESENT, AND FUTURE. Cloutier, R. J. (Oak Ridge Associated Universities, Inc., TN). pp 1305-1344 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Health physicists agree that the rapidly expanding use of nuclear energy is creating an increasing demand for persons trained in radiation protection. Any disagreement that does exist is limited primarily to the background and training required by persons entering the radiation protection field and the type of work the person should be trained to perform. Part of the difficulty is due to the broad scope of health physics. This situation is not limited to the United States but is worldwide. By classifying health physicists into types and reviewing past education and training programs, we will show how well these programs met their goals. In a similar manner, present education and training programs are examined in an attempt to evaluate whether they will meet our present and near-future health physics requirements. This type of review of past and present programs permits us to speculate on the training and education programs that will be most fruitful in meeting future needs for health physicists. (auth)

31579 TRAINING AND CERTIFICATION OF HEALTH PHYSICS TECHNICIANS. Kathren, R. L.; Waite, D. A. (Battelle Pacific Northwest Labs., Richland, WA). pp 1357-1372 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

At least twelve formal programs in radiation monitoring or radiation technology have been established at the post-high school level, many of which lead to an associate degree. These programs are described and compared in light of the needs and functions of the operational health physics technician. Actual experience with the establishment and operation of two such programs indicates a need for laboratory equipment, instructors with field experience, and support by the nuclear industry, particularly with regard to placement of personnel. To ensure a minimum level of competence among health physics technicians, a certification program patterned along the lines of that maintained by the American Board of Health Physics is proposed, but implemented by a combined board of Certified Health Physicists and health physics technicians. (auth)

31580 IDAHO NUCLEAR CORPORATION HEALTH PHYSICS TECHNICIAN TRAINING. Stroschein, H. W.; King, E. A.; Maeser, P. H.; McCaslin, J. W. (Idaho Nuclear Corp., Idaho Falls). pp

1373-1397 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

A two-part program consisting of a classroom training period and extended formal in-plant training is being conducted by Idaho Nuclear Corporation (IN) to train health physics technicians for radiation safety control. Both phases cover operational health physics practices such as instrumentation usage, radiation and contamination control, safe work permit procedures, and emergency actions. Training aids include vast physical facilities, two training manuals, an on-the-job training guide, and extensive instrumentation. The program is designed to train IN employed health physics technicians and Idaho State University Radiation Protection Technology students. The IN personnel are trained for working in IN operated nuclear reactor and radiochemical plant areas while the Idaho State University sessions are geared to provide broad health physics training to cover the needs of AEC contractors, universities, laboratories, and hospitals. The specific requirements and the program variations needed to accomplish training for each group are discussed. (auth)

31581 HEALTH PHYSICS INDOCTRINATION AND RE-INDOCTRINATION OF IDAHO NUCLEAR CORPORATION EMPLOYEES. Maeser, P. H.; King, E. A.; Stroschein, H. W.; McCaslin, J. W. (Idaho Nuclear Corp., Idaho Falls). pp 1399-1409 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

All new employees of Idaho Nuclear Corporation are required to attend a health physics indoctrination lecture. The presentation is devised to satisfy legal requirements, allay fears, correct misconceptions, acquaint employees with basic concepts of radiation and radiation protection, and familiarize them with company policies and plant procedures. The lecture includes the basic concepts of radiation, units of radiation measurement, biological effects of radiation, principles of radiation protection, contamination control procedures with demonstrations showing proper methods of donning and removing anticontamination clothing, and procedures to follow during emergencies. The Health Physics re-indoctrination program provides an annual review of some aspects of radiation safety procedures and policies for all Idaho Nuclear Corporation personnel working in radiation areas, and acquaints them with recent changes in radiation protection procedures. The re-indoctrination also provides a chance to ask questions on radiation safety that the employees did not have the opportunity, knowledge, or experience to ask on previous occasions. The presentation is varied from year to year as specific needs become apparent. These orientation lectures have increased job efficiency, decreased contamination spread, lowered radiation exposure, and resulted in better rapport between the average employee and the health physics department. (auth)

31582 SHORT COURSES IN EMERGENCY MONITORING FOR SAFETY AND MEDICAL PERSONNEL. Landolt, R. R.; Ziemer, P. L. (Purdue Univ., Lafayette, IN). pp 1411-1424 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

The health physics group at Purdue has established two short courses for acquainting safety and medical personnel with the fundamentals of radiation safety and the handling of radiation emergencies. One course, Basic Radiation Safety for Firefighting and Police Personnel, has been presented to all members of the University Fire and Police Department. It includes the broad topics of the technical aspects of Radiation Safety (definitions, types of hazards, principles of protection) and the practical aspects of Radiation Safety (University regulations, local hazards, use of monitoring equipment). The second course, "Basic Radiation Safety for Medical Personnel," has been presented to the doctors, nurses, and technicians of the University Health Service. In addition to topics covered in the fire and police course, medical aspects of radiation accidents and emergency preplanning for medical personnel are included in this course. (auth)

31583 ORGANIZATION OF A GRADUATE LEVEL HEALTH PHYSICS SURVEY COURSE. Porter, S. W. Jr. (Health Physics Society, Baltimore); Terpilak, M. S. pp 1425-1436 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

For the past four years, the Baltimore-Washington Chapter of the Health Physics Society in cooperation with the Training and Manpower Development Program, BRH has conducted a 78-hour graduate level health physics survey course as a refresher and a study guide for applicants preparing for the American Board of Health Physics Certification examination. The course material and agenda encompasses 26 specific topics that cover the major theoretical, operational, and practical aspects of Health Physics. The problems associated with the selection and choice of instructors, teaching techniques and methods, reference materials, and texts are presented. Solutions to the administrative problems concerned with low-budget funding and directing of such a course are suggested. The practical need for this type of education and training, along with suggested guidelines for course organization and presentation are discussed. (auth)

31584 ROLE OF RADIATION MONITORING IN EMERGENCY PREPAREDNESS. McBride, J. A.; Cunningham, R. E. (Atomic Energy Commission, Washington, DC). pp 1439-1454 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

The safety standards employed in the nuclear industry do not eliminate the potential for an emergency arising but only reduce the probability of such an occurrence. Since this is the case, plans must be developed in advance to cope with emergencies that are credible in any given operation. The most serious emergency should not serve as the sole basis for plan development. Rather, the plans should be designed to accommodate with greatest facility the more likely but less serious accidents. Emergency monitoring capability is an important part, but only a part, of emergency preparedness. It provides information about the nature and magnitude of the radiation hazard. Instruments used for emergency monitoring are frequently similar to those used in daily operational monitoring. In general, emergency monitoring instruments should be readily available, rugged, simple to operate, and capable of making rapid measurements. Personnel who perform emergency monitoring should be well trained in instrument operation, have a detailed knowledge of the emergency procedure, and be capable of performing their duties under conditions of great stress. (auth)

31585 PLAN FOR EMERGENCIES. Lonergan, G. T. (Argonne National Lab., IL). pp 1521-1561 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Argonne National Laboratory's organization for handling emergencies is designed to provide positive action directed at the protection of personnel and the minimization of property damage. The general plan for handling emergencies places the responsibility for evaluation and control of incidents in the hands of the local Area Emergency Supervisor. Responsibilities of both the local Area Emergency Supervisors and the Laboratory Emergency Coordinator are outlined. Notification of emergency response units and emergency supervisors is accomplished through the utilization of the Group Alerting System. Initial notification of a criticality is tied into the Group Alerting System. A summary of responsibilities of normally responding forces is presented. Preplanned actions of various response groups for specific types of emergencies are outlined. (auth)

31586 T^2WR (THINK, TALK, WRITE, AND REASON). Unruh, C. M. (Battelle Pacific Northwest Labs., Richland, WA). pp 1643-1651 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

The health physicist, if he is to be effective in his profession, needs to develop his communication capabilities with craftsmen, management, and the public. His communications should meet the needs of and be understood by those receiving them. Second only to a thorough knowledge of the principles of health physics, persuasion is the health physicist's biggest and best tool. By effective persuasion the health physicist should be able to accomplish his necessary work but he should always be ready to insist and to stand firm to assure a safe course of action should his persuasive efforts prove to be ineffective. Public communications in the health physics field should be frequent. The organizational

location of a health physics program in a corporate structure is optional. Good people will lead to a good program. In most situations an organizational position high in the corporate structure will help to assure proper importance and emphasis to the health physics program. In all cases clear lines of authority should be established and mutually understood by the health physicist, the craftsmen, and management. (auth)

31587 PUBLIC RELATIONS CONSTRAINTS ON HEALTH PHYSICS COMMUNICATIONS. Wegst, W. F. (California Inst. of Tech., Pasadena); Spangler, G. W. pp 1653-1665 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

The literature on Health Physics contains far too little information about radiation incidents. While many factors contribute to this unfortunate situation, public relations constraints probably dominate. This dearth of detailed radiation incident reports has undesirable consequences for the operational health physicist. He does not learn how a particular situation can develop, how it can be forestalled or handled or even that it is possible, until it happens to him. The impact on management is also serious; since few problems are reported, the feeling develops that radiological precautions are redundant, overly conservative, and largely unnecessary. It is imperative that the occurrence of radiation incidents be more freely communicated within the area of operational health physics. To this end the following set of rules for placating the public relations concerns was developed: Avoid scare words; never say kill or even injure, though deleterious consequences may be mentioned. Be mathematical; use equations wherever possible. Use jargon and technical terms; kerma is less likely than dose to cause adverse public relation reactions. Be upbeat; tell how things are being (or might be) improved, not how bad they were. Generalize; the reader should not be sure that the condition ever existed at your facility. Know your public relations specialist; each has his own concerns. Keep trying. As a last resort, get someone else to publish the paper. By following these rules operational health physics problems usually can be reported. (auth)

31588 MANAGEMENT REQUIREMENTS ON HEALTH PHYSICS. Remley, M. E. (Atomic International, Canoga Park, CA). pp 1667-1673 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Health Physics personnel fulfill a unique and most demanding position in most organizations. Their role is a functional one that could be eliminated if operations supervision were really completely effective in the monitoring and control of the safety of their operations. In our world of real people with supervisors subject to many varied demands, this latter condition does not exist. Health physics groups are established as organizational entities divorced from operations organizations to provide support to management in a staff capacity. They must develop health physics programs tailored to meet the requirements of the operational departments, monitor the programs to insure effective implementation of the programs by operational supervision, keep the programs evolving to keep pace with their company's evolving needs, and above all, assist in achieving their company's business goals. Meeting these objectives demands personnel with much more than just excellent technical capability. Attitude, mature judgement, administrative capability, personality, integrity, sense of responsibility, and character are all major requirements to qualify the health physicist to respond to above demands. His management leans heavily on the Health Physics staff to develop and provide technical information, together with the evaluation and perspective of the impact of the health physics requirements on the company's operations. These evaluations always involve a degree of subjectivity, and the management decisions based on the evaluations require some compromise. The most valuable health physicists are those who exploit such characteristics as those above to lead their managements to the most effective compromises and acceptable risks in their operations. The problems of achieving effective interaction and communications with management will be reviewed. (auth)

31589 OPERATIONAL HEALTH PHYSICS: IN-HOUSE OR COMMERCIAL SERVICES. Handloser, J. S. (EG and G, Inc., Santa Barbara, CA). pp 1675-1682 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Managers of facilities utilizing radioactive materials or radiation producing machines must decide how to obtain the best and most economical health physics services. The alternatives are to establish a health physics group at the facility, to purchase the services from outside or a combination of these. This paper examines the economic desirability of performing various health physics functions in-house as opposed to obtaining outside services. Functions such as health physics consultation, license procurement, personnel monitoring, instrument calibrations and repairs, waste disposal services, bioassay services, and training programs are considered. The natural tendency to establish in-house capabilities sometimes results in needless expense when the capability is available commercially. Conversely, the lack of a reliable commercial source often forces the decision to perform the tasks in-house. Factors involved in making these decisions include the number of people involved, the abilities of the individuals, the severity of the hazard, the location of the facility, the applicable regulations, and the availability and price of outside services. Special problems that can affect the decisions are discussed. (auth)

31590 MANAGEMENT AND HEALTH PHYSICS INTERACTION IN A LARGE FEDERAL AGENCY. Belvin, E. A.; Stone, G. F. (Tennessee Valley Authority, Muscle Shoals, AL). pp 1683-1695 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

The unique interrelationships of Tennessee Valley Authority organizational units that work together to control radiological hazards in a variety of operations are described. TVA is a Federal corporation created by the U. S. Congress as a resource development agency and governed by a 3-man Board of Directors appointed by the President and confirmed by the Senate. TVA's legislated responsibilities for controlling the Tennessee River and developing the Tennessee Valley are carried out through program delegations to its several offices and divisions. The industrial and Radiological Hygiene Staff organizationally is a part of the Division of Health and Safety which must communicate with varying levels of TVA management to ensure that potential radiation hazards are recognized early in the design stages of projects, that adequate controls are provided insofar as possible before operations commence, and that safe practices are followed after operations are in progress. Within the Division of Health and Safety itself, the professional health physics staff works closely with medical, environmental engineering, and safety staffs to formulate, implement, and keep under surveillance effective radiological control practices. The health physics program for the 3,456-MWe Browns Ferry Nuclear Plant is used as an example of effective communications in designing and planning the operations of a large nuclear power facility. (auth)

31591 NATIONWIDE HEALTH PHYSICS PROGRAM FOR A LARGE INDUSTRIAL USER. Wissink, R. G. (Minnesota Mining and Mfg. Co., St. Paul). pp 1697-1704 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Several methods can be used in establishing a health physics program for a large company that uses radioactive materials throughout the United States. When the extent of such usage ranges from a single beta gauge to enriched uranium fuel fabrication facilities, it becomes important to have some centralized responsibility and control. Through the efforts of one Health Physicist with broad responsibilities for licensing and accountability and a group of in-plant, trained Radiation Safety Officers, 3M Company has been able to successfully coordinate health physics activities under 56 licenses including a research and development license authorizing up to 22,000 curies of activity, a 1000 Kg special nuclear materials license, and a spent reactor fuel irradiation facility. To accomplish the objectives, the Health Physicist was placed in the Medical Department so that company divisional lines could be crossed and his functions expanded to include licensing administration and special nuclear materials accountability. In-plant responsibility was assigned to Radiation Safety Officers who were given 16 hours of radiation safety training. There have been four years of experience under 3M's program and no significant problems have been encountered. As the use of ionizing radiation increases within private industry and more Health Physicists are in positions where they will be establishing or revising industrial radiation safety programs, it is recommended that approaches similar to 3M's be used. (auth)

31592 IMPACT OF REGULATIONS, LICENSE CONDITIONS, AND INSPECTIONS ON THE OPERATIONAL RADIATION PROTECTION PROGRAM AT WASHINGTON STATE UNIVERSITY. Brown, R. C. (Washington State Univ., Pullman). pp 1707-1715 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Washington State University has had a broad byproduct materials license for the past seven years. This license has been administered by the Atomic Energy Commission through 1966 and by the Washington State Department of Health since January 1, 1967. During this seven year period there have been many changes in regulations, license conditions, and five inspections by appropriate agencies. The initial impact on the health physics group was that this maze of red tape and harassment by inspectors was of questionable value in our operational radiation protection program; however, subsequent experience has indicated that the impact of these regulations, license conditions, and inspections is one of the most desirable and beneficial aids to an effective operational radiation protection program for the following three reasons: An outside agency passes judgment on the overall radiation protection program pointing out weak areas and implying corrective measures. These agencies, along with their regulations and inspections, can effectively request the administration to implement practices and procedures that an operational health physics group would have great difficulty instituting. The most important aspect is that by complying with these agencies to the fullest possible extent the maintenance of a high quality operational radiation protection program is virtually assured. A brief summary of Washington State University's experience is included to illustrate the above three points. (auth)

31593 STATE RESPONSIBILITIES IN ESTABLISHING OFF-SITE EMERGENCY PLANS FOR NUCLEAR POWER REACTORS. Martin, J. E. (National Center for Radiological Health, Rockville, MD). pp 1825-1835 of Health Physics Operational Monitoring. Vol. 3. Willis, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From third Health Physics Society midyear topical symposium; Los Angeles, California, USA (29 Jan 1969). See CONF-690103-P3.

Only State health agencies have the authority to initiate actions in the public domain to protect populations in the event of radiation accidents. This authority and its concomitant responsibility require State health departments to develop emergency plans to resolve any consequences of incidental or accidental off-site releases of radioactivity from nuclear facilities, especially for nuclear power reactors. Experience gained by the Public Health Service in assisting several States in developing such plans for nuclear power stations is discussed. Emphasis is placed on problem areas encountered such as delineation of authority and responsibility to act, notification criteria, monitoring techniques, protective action guides, evacuation of populated areas, and relative risks. Examples of these problems and experience gained in solving them are given, gaps in current practice are discussed, and possible solutions for certain problems are suggested. The material presented is based on several years of experience by the Public Health Service in carrying out its traditional responsibility of assisting States with radiological health programs. Because of the growth of nuclear power many States are now developing emergency plans for reactors. Work with these States has been valuable in developing plans for others, showing areas where additional study is needed, and indicating the need to provide resources at the Federal health level. In this context, resources available from the Public Health Service to supplement those of State health agencies are discussed. (auth)

Mathematics and Computers

Refer also to abstracts 29741, 29887, 31542, 31564, and 31647.

31594 (AERE-R-7673) ON-LINE SEARCHING OF COUNCIL OF EUROPE CONVENTIONS AND AGREEMENTS: A STUDY IN BILINGUAL DOCUMENT RETRIEVAL. Price, N. H.; Bye, C.; Niblett, B. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1974. 15p. Dep. NTIS (U. S. Sales Only) $4.00. UK 50 pence.

At the Second International Conference on Mechanised Information Storage and Retrieval held at Cranfield in 1969, results were presented illustrating the application of a suite of computer programs (the STATUS package) to the searching of the full text of UK atomic energy legislation. These programs were at that time implemented on a KDF9 computer at the Culham Laboratory. Since then the programs have been rewritten in modified form for the IBM 370/165 machine at Harwell and used to search (both in batch mode and on-line) the text of material supplied by the Council of Europe, The Agreements, Conventions, and Protocols concluded between the Member States of the Council of Europe are a largely self-contained set of documents admirably suited for a small-scale full-text retrieval system. They cover a wide range of subject matter including economic, social, cultural, scientific, legal and administrative topics. The best known and the most important of the Conventions is that concerned with the Protection of Human Rights and Fundamental Freedoms. A feature of particular interest is that English and French are the official languages of the organization. The total size of the text is some 200,000 words in each language. (MCW)

31595 (ANL-8076) COMPUTER-AUTOMATED TOPOLOGICAL NETWORK DESIGN FOR INTEGRATED-CIRCUIT CHASSIS. Snow, W. J. (Argonne National Lab., Ill. (USA)). Feb 1974. Contract W-7405-109-eng-38. 140p. Dep. NTIS $5.45.

A computer system has been written in PL/1 that produces data that is used as input for an automatic programmed wire wrap machine from various logical design characteristics. The program permits a maximum degree of design sophistication through complete flexibility in the description of circuit boards and numerous different types of integrated circuit modules. Many diagnostic analysis routines are provided as a check for the design effort against established criteria of various system acceptabilities. The printed program output is presented in a format for useful documentation of the entire design system. (auth)

31596 (BNL-18733) BROOKHAVEN COMPUTER USER'S GUIDE. Fuchel, K.; Padwa, S. L.; Scott, A.; Stewart, C. (Brookhaven National Lab., Upton, N. Y. (USA)). Jan 1974. 90p. Dep. NTIS $7.50.

31597 (COO-1428-371) SCHEDULING MODEL FOR COMPUTER SYSTEMS WITH TWO CLASSES OF PROCESSORS. Buten, R. E.; Shen, V. Y. (Purdue Univ., Lafayette, Ind. (USA)). 1972. 9p. (CONF-730832-2). Dep. NTIS $3.00.

From Sagamore computer conference on parallel processing; Syracuse, New York, USA (22 Aug 1973).

A simple algorithm to schedule a restricted set of jobs on a multiprocessor system with two classes of processors is described. Through deterministic analysis an upper bound is established for the behavior of the algorithm. This bound is seen to compare favorably with the upper bound intrinsic to the model. Simulation results show the algorithms to be useful in scheduling less restricted job sets. (auth)

31598 (COO-2383-2) ICGS SYSTEM: SYSTEM TABLES MANUAL. Mueller, D. H. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Feb 1974. Contract AT(11-1)-2383. 18p. (UIUCDCS-R-74-609). Dep. NTIS $4.00.

The Illinois Computing Graphics System (ICGS) is a batch system for a minicomputer. It executes a limited number of system programs, and provides facilities for rapid overlaying of these programs. This manual is intended to aid the system programmer in setting up the system tables. (auth)

31599 (CTC-INF-1083) IMPACT OF TELECOMMUNICATIONS ON COMPUTER OPERATIONS MANAGEMENT. A Trade-off: Efficiency vs Responsiveness. Allen, C. L. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 1974. 8p. (CONF-740405-1). Dep. NTIS $4.00.

From AESOP-X conference; Albuquerque, New Mexico, USA (2 Apr 1974).

31600 (ITF-73-149-P) ASYMPTOTIC PROPERTIES OF THE ISING MODEL WITH POSITIVE LONG-RANGE INTERACTION. Lapushkin, S. S.; Plechko, V. N. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The Ising model with a positive long-range interaction is investigated. Asymptotically exact expressions for a free energy and magnetization are found. It is shown that the positive long-range interaction in the case of absence of an external magnetic field is negligible, but in the case of nonzero external field it leads to demagnetization. The treatment of the model is mathematically rigorous. (auth)

31601 (KFK-1734) MULTIPLE COPY FILES IN COMPUTER NETWORKS. Holler, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Datenverarbeitung in der Technik). Feb 1974. 21p. Dep. NTIS (U. S. Sales Only) $4.25.

Depending on the ratio of update to query traffic for a file in a computer network, a multiple copy file allocation may be more economical than a single copy allocation. For symmetrical and homogeneous computer networks an upper limit for the ratio of update to query traffic is given, for which the multi-node assignment of a file represents an economic solution. In addition, a decentralized control mechanism for synchronizing the updating

of a file with multiple copies is shown. The mechanism guarantees consistency of the information stored in different copies of a file by ensuring that updating requests are executed in the same order as all copies of the file. Identical queries issued between two consecutive updatings will yield the same result, regardless of the copy they use. (auth)

31602 (KFK-1898) DATA LOGGER IN APL-PLUS. Ziegler, H. J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorbauelemente). Feb 1974. 26p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

A program is presented for rapid evaluation of personnel data, which allows to establish data inventories by means of the dialogue system APL and to compile them in a written form following various criteria of selection. The main goal in developing the program was to achieve optimum adaption to user's needs, allowing even the user without knowledge of programming to perform electronic data acquisition and evaluation. Assistance by a programmer will be required only during the short initial phase of training. (auth)

31603 (KFKI-74-9) SIMULATION OF TIME IN THE CASE OF QUASISYNCHRONOUS DISCRETE EVENT DISTRIBUTIONS. Javor, A. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Feb 1974. 25p. Dep. NTIS (U. S. Sales Only) $4.50.

It is suggested that in a large number of discrete-event systems the distribution of events in time is clustered (i.e., burst-like), and the term quasisynchronous discrete event distribution is defined to describe such cases. This a priori known information on the event distributions is exploited to develop efficient time simulation algorithms. The main features of the methods proposed are the separate handling of the time periods with high event densities (peak intervals) and the utilization of a hierarchical event controlled time advancement structure (HECTAS) which is flexibly adaptive to the actual requirements. The mathematical analysis of the above structures and its results for determining actual system parameters are provided. (5 figures) (auth)

31604 (LA-UR-74-500) COMPUTER GENERATED MOVIES: ANOTHER DIMENSION IN MAN-MACHINE COMMUNICATIONS. Elliott, R. L.; Orr, S. R.; Pequette, E. C. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. 3p. (CONF-740512-1). Dep. NTIS $4.00.

From 2nd AEC scientific computer information exchange meeting; New York, New York, USA (2 May 1974).

A typical hydrodynamic physics program may run up to 20 hours on a CDC 7600 computer and generate up to a billion numbers. The biggest problem facing the users of these programs is simply comprehending what has been calculated. Stacks of computer listings are typical outputs but serve as a poor communication medium. Static pictures are much better than listings but are limited to two dimensions. Through the use of movies, one adds a third dimension to the communication process. The evolution of computer generated movies at Los Alamos Scientific Laboratory and the techniques now in use are described. (auth)

31605 (LA-UR-74-509) APPLICATIONS OF COMPUTER-GENERATED PERSPECTIVE PLOTS. Prueitt, M. L. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. 27p. (CONF-740512-2). Dep. NTIS $4.50.

From 2nd AEC scientific computer information exchange meeting; New York, New York, USA (2 May 1974).

Graphical output from a computer is easily interpreted. Perspective plots are presently the best way to communicate large amounts of information to man from the computer. A magnetic field was generated in the path of the accelerator beam and the shape of the magnetic field was plotted. The PICTURE program was also used to calculate laser absorption on a material as a function of angle of incidence and depth of penetration. Cn cross-sections as a function of photon frequency and temperature; chemical equilibrium of a chemical solution; generation of patterns; shape of fragments of material as they traveled away from the center of an explosion; nuclear spectra for several isotopes; detect errors in large computer programs; displaying functions of two variables; displaying underground formations; map of ocean floor; and shock-wave data are examples given. (MCW)

31606 (ORNL-4946) ADKWIC: A PL/1 PROGRAM TO PRODUCE KWIC OR KWOC INDEXES FROM ADSEP DATA BASES. Hammerling, F. D. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 21p. Dep. NTIS $4.00.

ADKWIC is a PL/1 program which produces a KWIC (Key Word In Context) or KWOC (Key Word Out Of Context) index from an ADSEP data base. Page formatting and program options are controlled by input parameters. The program can easily be modified to run from input other than ADSEP format. The program is part of the ORCHIS Information System. (auth)

31607 (SLA-73-966) TIME CODE DECODER FOR MINICOMPUTERS. Veneruso, A. F. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 26p. Dep. NTIS $4.50.

A time code decoder designed to decode the second, minute, hour, and day information contained in the IRIG-Format B time code is described. The results of laboratory tests conducted to demonstrate the decoder's capability are presented, and software changes that enable the decoder to decode any other time code format are discussed. Specifically, the decoder program modifications required for operation with the IRIG-A, NASA 36-Bit, and White Sands Missile Range Type G-2 time codes are presented. (auth)

31608 (SLA-73-1029) DIGITAL COORDINATE TRANSLATOR FOR THE MPS-25 RADAR. Minnear, L. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 77p. Dep. NTIS $7.00.

A device is described that translates the three polar coordinates of the MPS-25 radar expressed in binary form into engineering units. A time shared serial multiplier circuit and dedicated binary-to-BCD conversion circuits are used. Included are design details of the double/dabble conversion circuits as well as general number conversion techniques. (auth)

31609 (SLA-73-1038) VISAR DATA REDUCTION. Barker, L. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. 55p. Dep. NTIS $4.75.

The data reduction theory that allows both specimen surface velocity and surface velocity distribution to be determined from the data of the Velocity Interferometer System for Any Reflector (VISAR) is presented. Two time-sharing, user-interactive computer programs that implement the theory are described, and the program listings are provided. (auth)

31610 (SLA-73-1078) OPERATION AND MAINTENANCE MANUAL FOR SANDIA IMAGE DIGITIZER. Cover, R. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 53p. Dep. NTIS $5.75.

The digital logic in the Sandia Image Digitizer (SID) which is a high speed scanner, attached to a DEC PDP 8, 8/I, 8/E computer is described. SID will scan and convert any two-dimensional black-and-white sketch, drawing, graph or photograph into sequence of x, y coordinates suitable for computer processing. The resolution is 500 × 500 and total digitizing time is less than ½ second. (auth)

31611 (SLA-73-1118) EMR 6130 COMPUTER ON-LINE STATION: CALCOMP 566 X-Y PLOTTER. Longerot, C. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 35p. Dep. NTIS $4.75.

The electronic instrumentation designed to provide an on-line interface between the Calcomp 566 X-Y plotter and the centralized EMR 6130 real-time/time-share computer is described. The instrumentation along with a high-level software package provides good quality X-Y plot capabilities to users of the EMR 6130 facility. (auth)

31612 (SLA-74-5068) SYNCH SETS: A VARIANT OF DIFFERENCE SETS. Simmons, G. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 22p. (CONF-740217-1). Dep. NTIS $3.25.

From 5th southeastern conference on combinatorics, graph theory and computing; Boca Raton, Florida, USA (2 Feb 1974).

An S(k,λ) synch-set is defined to be a set of k non-negative integers for which not more than λ pairs have a common difference. Clearly, an (n,k,λ) difference set is also an S(k',λ) synch-set where k = k', however, for a specified largest element it is generally possible to achieve k' > k or equivalently the largest element in a synch-set for a fixed k can be less than for the corresponding difference set. For example, for k = 10 the least upper bound for a planar difference set is 81 for the (91,10,1) set while (0,1,6,10,23,26,34,41,53,55) is a S(10,1) set which realizes an upper bound of 55. Best possible constructions are given for most k ≤ 15. Applications are made involving a problem that arose in the design of a satellite optical scanner system for determining the location of an intense point light source on the surface of the Earth. (auth)

31613 (SLA-74-5256) CDC 6600 SUBROUTINES IBESS AND JBESS FOR BESSEL FUNCTIONS $I_\nu(x)$ AND $J_\nu(x)$, $X \geq 0$, $\nu \geq 0$. Amos, D. E.; Daniel, S. L.; Weston, M. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 20p. (CONF-740511-1). Dep. NTIS $4.00.

From mathematical software II conference; Lafayette, Indiana, USA (29 May 1974).

IBESS and JBESS implement power series for $(x/2)^2 \leq \nu + 1$ and uniform asymptotic expansions for $\nu \to \infty$ when $\nu \geq 32$ and $(x/2)^2 > \nu + 1$. For pairs (ν,x) not covered by these formulae, ν is raised by a positive integer (never more than 34), a formula is applied, and the order is reduced to its original value by back-

ward recursion on the three term recursion relation. Sequences, with the order incremented by one, are easily obtained, and an option for exponential scaling of $I_v(x)$ is provided. Over and underflow tests are made, when appropriate, so that accurate answers are obtained when the results are on scale. Correspondingly, appropriate diagnostics are printed when the results are off scale. (auth)

31614 (SLL-74-214) CDC 6600 ROUTINES FOR THE INTERPOLATION OF DATA AND OF DATA WITH DERIVATIVES. Huddleston, R. E. (Sandia Labs., Livermore, Calif. (USA)). Apr 1974. Contract AT(29-1)-789. 25p. Dep. NTIS $4.25.

Subroutines POLINT, HRMITE, POLYVL, and POLCOF were written to provide a documented interpolation capability. Subroutine POLINT calculates the Newton form of the interpolating polynomial. Subroutine HRMITE calculates the Newton form of the Hermite interpolating polynomial (i.e., where data and derivatives are given). Subroutines POLYVL and POLCOF use the information generated by POLINT and HRMITE to evaluate the interpolation polynomial together with its derivatives and produce the coefficients of the fitting polynomial. (auth)

31615 (UCID-30089) SHEMP: A SERVICE PROGRAM FOR THE HEMP PROGRAM. Leibee, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1974. Contract W-7405-eng-48. 190p. Dep. NTIS $12.50.

SHEMP services the computer program HEMP, which solves the conservation equations of two-dimensional elastic-plastic flow. SHEMP restructures the two-dimensional grid that HEMP outputs to tape as a restart dump. SHEMP writes this restructured grid to tape so that HEMP can restart and run from it. SHEMP is written in an extended FORTRAN IV language (LRLTRAN as implemented on the CHAT compiler) and is run on the Laboratory's CDC 7600 computer system. (auth)

31616 (UCLA-34-P-201-8) ENERGY WAVE NUMBER CHARACTERISTICS FOR CUBIC SYSTEMS WITH ANISOTROPIC LINEAR-EXPANSION-COEFFICIENT TENSOR. Fifth Topical Progress Report, January 1–December 31, 1973. Yamauchi, H.; de Fontaine, D. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Dec 1973. Contract AT(04-3)-34. 33p. (UCLA-ENG-7398). Dep. NTIS $4.75.

Two different force constant models are studied numerically in order to determine the elastic energy wave number characteristics (EWNC) for cubic crystals when the linear-expansion-coefficient tensors are anisotropically diagonalized. For the previously offered model (Model I), a general expression for EWNC is derived. A new model (Model II) based on nearest-neighbor coupling is presented. EWNC for Fe, Ni and Cu are numerically calculated for both models. The different models generally yield different EWNC's for the same case. However, the values of the EWNC at the origin of the first Brillouin zone (the continuum limit) are always model independent and agree with those calculated by the linear continuum theory of elasticity. (auth)

31617 (UCRL-51079(Rev.1)) HEMP USER'S MANUAL. Giroux, E. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Dec 1973. Contract W-7405-Eng-48. 206p. Dep. NTIS $7.60.

A computer program to solve the conservation equations of two-dimensional elastic-plastic flow has been implemented at LLL on the CDC 7600 machine. The program, named HEMP, is written in an expanded FORTRAN IV language. This user's manual explains the operation and use of the program. A section is provided that will aid in converting the program to other machines and systems. (auth)

Miscellaneous

31618 (ITF-73-180-P) EXCITON STATES IN TWO-DIMENSIONAL MOLECULAR STRUCTURES. Davydov, A. S.; Kislukha, N. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 16p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

The intramolecular excitation in two-dimensional molecular structures is investigated taking into account their deformation caused by the excitation itself. It is shown that the possibility or impossibility of localization of the excitation in a limited region of a film of infinite size is dependent on the relation between the values of Van der Waals (D) and resonance (M) interactions and the value of W determining the deformability properties of a molecular structure. (auth)

31619 (TID-26540-P1) 1973 ATOMIC ENERGY PROGRAMS. Volume 1. Operating and Developmental Functions. (USAEC, Washington, D. C.). 1973. 122p. GPO $1.60.

The eleven chapters cover: summary of 1973 activities, general energy development, breeder reactors, reactor safety, fusion power, environmental challenge, life sciences, physical sciences, nuclear materials, national security, and radioactive wastes. The makeup and activities of statutory committees are also described. (DLC)

31620 (TID-26540-P2) 1973 ANNUAL REPORT TO CONGRESS. Volume 2. Regulatory Activities. (USAEC, Washington, D. C.). 1973. 96p. GPO.

After an overview of the energy crisis, the following eight chapters cover: 1973 nuclear power licensing, fuel cycle, protecting the public safety, protecting the environment, nuclear operations surveillance, regulatory standards, and public participation in regulation. Statutory committees/boards, rules and regulations, and AEC regulatory guides are listed in the appendix. (DLC)

31621 (UCRL-51517) CONSTRAINED MINIMIZATION OF A FUNCTION OF MANY VARIABLES. Radcliffe, C. W.; Comfort, W. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jan 1974. Contract W-7405-eng-48. 22p. Dep. NTIS $4.00.

Powell's direct search method for finding the minimum or maximum of a function of many variables has been modified to allow inequality and equality constraints—either or both—to be imposed. The modification involves a transformation of the constrained problem into an artificial unconstrained minimization problem by the addition of penalty functions to the actual function being minimized. The technique is of general applicability in optimization problems encountered in engineering and physics. A unique feature is the automatic generation of weighting factors which provide scaling of the constraint function being minimized. Automatic scaling simplifies preparation of the problem and accelerates convergence. (auth)

Chemistry

31622 (AD-772911-4-WE) INVESTIGATING WASTE OIL DISPOSAL BY COMBUSTION. DeBono, G. (Coating and Chemical Lab., Aberdeen Proving Ground, Md. (USA)). Jan 1974. 18p. NTIS $3.00.

In response to efforts directed towards waste oil disposal, APG Post Engineers initiated a program in 1968 whereby waste oil was introduced into No. 6 Fuel Oil and subsequently burned for heat. Because of the heavy consistency of No. 6 Fuel Oil, no operational difficulties occurred. However, in August 1972, APG switched to No. 2 Fuel Oil and some concern was generated regarding the miscibility of the waste oil with a lighter fuel. To date, no maintenance problems have resulted from burning the waste oil, nor have any emission levels been exceeded. However, these results may be due to the relative lightness of the waste oil and the low waste oil/fuel oil dilution ratio (1%) in which they are burned. (auth)

31623 (COO-2166-11) EXPERIMENTAL TECHNIQUES FOR STUDYING GRAIN BOUNDARY CHEMISTRY. Stein, D. F.; Johnson, W. C.; White, C. L. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1973. Contract AT(11-1)-2166. 42p. (CONF-730727-2). Dep. NTIS $4.25.

From international summer school on grain boundaries; Montreal, Canada (2 Jul 1973).

A review of the techniques used to study the chemistry of near grain boundary regions is given. The traditional techniques of radiography, chemical etching, and microprobe are discussed and their limitations are pointed out. New techniques are presented such as ion scattering spectrometry, electron spectroscopy for chemical analysis, ion backscattering spectrometry, and Auger electron spectroscopy. The success of these new techniques indicates that they will prove most useful. (auth)

31624 (JUL-1028-RW) CONTRIBUTION TO INVESTIGATION OF PERTURBING INFLUENCES IN THE QUANTITATIVE SPECTRAL ANALYSIS OF Al ALLOYS. Stachova, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe). Dec 1973. 93p. (In German). Dep. NTIS (U. S. Sales Only) $7.75.

Studies were made of the influence of different perturbing parameters in quantitative spectrochemical analysis subjected to spark discharge at high voltage of aluminium alloys. In particular the effect of type and concentration of alloying elements, the effect of the discharge gas and the effect of the mechanical condition of electrode surface on the measured results are examined. It is found that the composition of a multi-component system similar to the physical properties of the discharge gas affects the evaporation behavior of the single alloy components. Beyond that different discharge gases cause a change of the excitation processes. In addition it is possible to prove that the measured results of the quantitative spectral analysis depend on the metallurgical properties of the alloy. The different re-

sults of this study are discussed, tested on their mutual dependence, and explained in models. (auth)

31625 (LBL-2507) HIGH-TEMPERATURE MASS SPECTROMETRY. Roberts, J. A. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1974. Contract W-7405-eng-48. 112p. Dep. NTIS $8.75.

Thesis.

Two investigations demonstrating new aspects of the high-temperature Knudsen cell mass spectrometer technique have been made. The intensities of mass spectrometer ion peaks attributable to $CeF_3(g)$ and $Ce_2F_6(g)$ have been measured as functions of temperature for the equilibrium vapor over $CeF_3(s)$. These results, plus new measurements of the partial vapor pressures over $LaF_3(s)$ cast doubt on an explanation suggested by Skinner and Searcy for their anomalous measured entropies of $LaF_3(g)$ dimerization. Partial pressure vs composition at constant composition curves for the two major vapor species, $S_2(g)$ and $Ga_2S(g)$, have also been constructed. An anomaly found when the phase transition at 1230°K is traversed wherein the $Ga_2S(g)$ partial pressure temporarily increases when the temperature is decreased is explained by reference to schematic equilibrium free energy diagrams. (LK)

31626 (ORNL-TM-4370, pp 158-243) HIGH-RESOLUTION ANALYTICAL SYSTEMS. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

High-resolution separation and analyses of complex biochemical mixtures have been achieved using liquid chromatographic analyzers which employ colorimetric-, ultraviolet-, or fluorescence-detecting flow monitors. A small computer system has been developed and built which can simultaneously monitor four channels of information from two chromatographs in real-time while analyzing the data from one channel either on-line or from a previous run stored on a cassette tape. (LK)

31627 (PB-224571-0-GA) FLOTATION OF PYRITE FROM COAL: PILOT PLANT STUDY. Report of Investigations. Miller, K. J. (Bureau of Mines, Washington, D. C. (USA)). Sep 1973. 20p. NTIS $2.75.

The report presents results of pilot plant flotation tests to remove pyritic sulfur from a Pittsburgh bed coal and Lower Freeport bed coal using a new two-stage flotation process developed by the U. S. Bureau of Mines. Pilot plant flotation test results were excellent comparing well with those obtained in the laboratory. Tabulated and graphic results are given along with a pilot plant flow-sheet and a photograph of the flotation cells in operation. (GRA)

31628 (UCRL-75096) SMALL, MINI-COMPUTER-AUTOMATED THERMOANALYTICAL LABORATORY. Catalano, E.; English, J. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Nov 1973. 8p. (CONF-740315-1). Dep. NTIS $3.00.

From 3rd analytical calorimetry symposium; Los Angeles, California, USA (31 Mar 1974).

This facility meets the analytical service requirements and the philosophical operational requirements. It is exceptionally successful in optimizing individual productivity and reducing tedium associated with routine service work by cutting down the number of analyses repeated due to operator misjudgement and accidents. Furthermore, it delivers a generally higher quality of data than services supplied in a manual manner by the same operators. Especially valuable is the fact that it releases time for research activities and that there is enough flexibility to continually add to or change the particular variety of problems at hand. (auth)

Life Sciences

31629 (CEA-CONF-2517) EXPERIMENTAL INVESTIGATIONS, AT LABORATORY, ON THE TRANSFER OF MERCURY IN MARINE TROPHIC CHAINS. Laumond, F.; Neuburger, M.; Donnier, B.; Fourcy, A.; Bittel, R.; Aubert, M. (Institut National de la Sante et de la Recherche Medicale (INSERM), 06–Nice (France). Centre d'Etudes et de Recherches Medicales de Biologie et d'Oceanographie Medicale (Cerbom)). 1973. 8p. (CONF-730995-1). Dep. NTIS (U.S. Sales Only) $3.00.

From study group on genetical methods of pest control; Louvain, Belgium (11 Sep 1973).

Results are reported from laboratory studies on the transfer of Hg to fish and mussels in marine food chains. (CH)

31630 (COO-1422-160) INTERNATIONAL CONFERENCE ON BONE MINERAL MEASUREMENT, OCTOBER 12–13, 1973, CHICAGO, ILLINOIS. (Wisconsin Univ., Madison (USA). Bone Mineral Lab.). 1973. 55p. (CONF-731036-(Absts.)). Dep. NTIS (U. S. Sales Only) $4.75.

From international conference on bone mineral measurement; Chicago, Illinois, USA (12 Oct 1973).

Abstracts of papers presented at the international conference on bone mineral measurement are presented. The papers were grouped into two sessions: a physical session including papers on measuring techniques, errors, interpretation and correlations, dual photon techniques, and data handling and exchange; a biomedical session including papers on bone disease, osteoporosis, normative data, non-disease influences, renal, and activity and inactivity. (ERB)

31631 (COO-1599-79) DISSOLVED ORGANIC MATTER AND LAKE METABOLISM. Technical Progress Report, 1 April 1973–31 March 1974. Wetzel, G. H. (Michigan State Univ., East Lansing (USA)). 1974. Contract AT(11-1)-1599. 32p. Dep. NTIS $4.75.

A detailed temporal and spatial carbon budget, essentially a functional detrital carbon budget, was evaluated for an oligotrophic lake system. Emphasis was placed on the fate and mechanisms regulating the qualitative and quantitative utilization and losses of organic carbon. (CH)

31632 (COO-2208-6) AVAILABLE SPACE FOR A TOTALLY IMPLANTABLE CARDIAC PROSTHESIS. Annual Progress Report, April 1, 1973–March 31, 1974. Nose, Y. (Cleveland Clinic Foundation, Ohio (USA). Dept. of Artificial Organs). 2 Apr 1974. Contract AT(11-1)-2208. 110p. Dep. NTIS $8.50.

Methods were developed for generating an integrated, statistical model of the anatomical structures within the human thorax relevant to radioisotope powered artificial heart implantation. These methods involve measurement and analysis of anatomy in four areas: chest wall, pericardium, vascular connections, and great vessels. A model for the prediction of thorax outline from radiograms was finalized. These models were combined with 100 radiograms to arrive at a size distribution representing the adult male and female populations. (CH)

31633 (FDA-73-8029, pp 502-509) GROWTH OF ANIMALS UNDER THE INFLUENCE OF ELECTRIC AND MAGNETIC FIELDS. Giarola, A. J.; Krueger, W. F.; Neff, R. D. (Texas A and M Univ., College Station). Mar 1973.

In health physics in the healing arts.

31634 (ORNL-NSF-EATC-4) SURVEY OF MERCURY USAGE BY AGENCIES OF THE UNITED STATES GOVERNMENT DURING 1971. Clark, W. E. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. 171p. Dep. NTIS $11.75.

31635 (ORNL-NSF-EATC-6) ECOLOGY AND ANALYSIS OF TRACE CONTAMINANTS. Progress Report, January 1973–September 1973. Fulkerson, W.; Shults, W. D.; Van Hook, R. I. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 438p. Dep. NTIS $24.00.

This is the second progress report of the Oak Ridge National Laboratory Ecology and Analysis of Trace Contaminants Project sponsored by the Environmental Aspects of Trace Contaminants Program of NSF/RANN. The objective of the work is to develop techniques and information that will be useful in assessing the environmental impact of toxic trace substances and in reducing discharges of these materials. The work is not specific to any one trace contaminant, but much of the effort to date has been focused on toxic elements. The research involves five areas: development of a Unified Transport Model for trace contaminants; ecological research to characterize the translocation and accumulation of trace elements in the environment; measurements research to improve analytical efficiency and capability; development of aqueous abatement technology; and information flow and management. (ERB)

31636 (ORNL-TM-4370, pp 142-157) GENETIC MONITORING. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

A system for preparing plasma, washed red blood cells, and red blood cell lysates is under development. Preliminary work has begun on an automated elution electrophoresis system to improve the resolution and speed of electrophoresis, and the adaptation of the computerized Centrifugal Fast Analyzer to evaluate kinetic enzyme parameters as another means of genetic screening is being studied. (auth)

31637 (ORNL-TM-4370, pp 244-280) MACROMOLECULAR SEPARATIONS. Feb 1974.

In Chemical Development Section B semiannual progress report, March 1, 1973–August 31, 1973. Part I.

Affinity chromatography techniques have been applied to the problem of purification of erythropoietin from anemic sheep plasma. (LK)

Materials

31638 (CEA-CONF-2452) PLOTTING OF DEPTH DISTRIBUTION OF IMPURITIES WITH THE CASTAING–SLODZIAN ION ANALYSER. Blanchard, B.; Hilleret, N.; Quoirin, J. B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 22 Aug 1973. 20p. (In French). (CONF-730314-2). Dep. NTIS (U. S. Sales Only) $3.00.

From 24th Pittsburgh conference on analytical chemistry and applied spectroscopy; Cleveland, Ohio, USA (5 Mar 1973).

The operating conditions for obtaining depth distributions with a detection limit of less than 5×10^{16} atoms/cm^3 for the boron and 5×10^{17} atoms/cm^3 for the arsenic in silicon are described. Flat bottomed and sharp-edged pits are eroded to have a good depth resolution (better than 100 Å) and to limit the redeposition phenomena. With an automatic microleak an oxygen pressure (about 10^{-4} T) is maintained for increasing the sensitivity. In this condition the ionic yield becomes the same for the boron, emitting either silica or silicon. Calibration in concentration was performed with the help of standards in the case of boron and from the total measurement by nuclear reaction in the case of arsenic. Boron and arsenic profiles in silicon, implanted boron profiles in silica, and aluminum profiles in epitaxied silicon are shown. (tr-auth)

31639 (CEA-R-4558) ELASTORESISTIVITY OF POINT DEFECTS IN COPPER. von Stebut, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Dec 1973. 148p. (In French). Dep. NTIS (U. S. Sales Only) $9.50.

Thesis. Submitted to Paris Univ., Orsay (France).

Three parameters were studied of the same polycrystalline copper sample: electrical resistivity ρ, static Young's modulus E, and elastoresistance coefficient K_L (= strain gauge coefficient). Results concerning resistivity of copper show that the rate of radiation damage is not related to the overall dislocation density but rather to the density of isolated dislocations. The latter are produced by plastic deformation at room temperature. For as-received cold drawn copper wires (purity: 99.999%) a decrease of the static Young's modulus during the initial stage of 20 K neutron irradiation was found. This decrease is due to radiation annealing of pinning points composed of impurity trapped vacancies. The latter are created beforehand by a small plastic deformation. It is shown that in copper the uniaxial elastoresistivity is a parameter especially sensitive to impurities and intrinsic interstitials but not to vacancies. The uniaxial elastoresistivity of point defects in copper obeys Matthiessen's rule. For more than 95% of the intrinsic point defects annealing out in stage III, the migration of the dumbbell-interstitial can be ruled out. (tr-auth)

31640 (COO-1794-18) STRENGTHENING AND TOUGHENING OF BRITTLE MATERIALS. Progress Report, January 31, 1973–January 31, 1974. Broutman, L. J.; Mallick, P. K. (Illinois Inst. of Tech., Chicago (USA)). 1974. Contract AT(11-1)-1794. 202p. Dep. NTIS $12.25.

Studies were conducted on spherical particle and fibrous composites. The six reprints deal with: three-dimensional finite-element analysis, effects of interface on mechanical properties of low aspect ratio fiber composites, reinforcement of epoxy resins with potassium titanate whiskers, mechanical properties of glass bead-filled epoxy composites, and interfacial layer effects on properties of composites. (DLC)

31641 (COO-3158-25) FACETING OF HIGH ANGLE GRAIN BOUNDARIES IN THE COINCIDENCE LATTICE. Wagner, W. R.; Tan, T. Y.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). 16 Nov 1973. Contract AT(11-1)-3158. 19p. Dep. NTIS $3.00.

Faceting of high angle grain boundaries in $\Sigma = 3$ and $\Sigma = 5$ coincidence lattices of the fcc structure was studied using thin-film bicrystal specimens of controlled geometry. A number of relatively high index boundaries in the coincidence lattices (containing relatively low planar densities of coincidence sites) was found to break up into low energy facets corresponding to low index planes of the coincidence lattices (containing high densities of coincidence lattice sites). These results are consistent with a general expectation that the grain boundary energy decreases as the planar density of coincidence sites increases, i.e., the two-dimensional periodicity of the boundary becomes shorter, and long-ranged distortions are reduced. (auth)

31642 (GKSS-73-E-28) MEWAK I: A DESALINATION MATERIALS CORROSION TEST LOOP. Bulda, F.; Froehner, K. R.; Schmitt, F. J. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (F. R. Germany)). 1973. 15p. (In Several Languages). (CONF-730904-6). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth international symposium on fresh water from the sea; Heidelberg, F. R. Germany (9 Sep 1973).

A corrosion test loop was set up that provides several possibilities in corrosion testing of desalination plant materials, e.g. condenser tubes, piping, valves and fittings, and specimens of various shape and size. Sea water is delivered 100 miles to MEWAK I by truck and stored in tanks. After treatment, concentration to brine, and make-up, the water serves to continuously refurbish the brine circulating in the test loop. Main operation parameters at present are: brine concentration = threefold sea water salt concentration, temperature 115 to 125°C, brine velocity within condenser tubes 4 m/s, heat transfer through test tube walls of about 15 watts/cm^2, refurbishing rate 3 1/h per 800 l test loop capacity. The general lay-out of MEWAK I brings more severe corrosion conditions into reach. (tr-auth)

31643 (IS-T-633) LOW TEMPERATURE ABSORPTION SPECTRA AND ENERGY LEVELS OF HoF_3 IN THE REGIONS 21625 cm^{-1} to 21360 cm^{-1} AND 26160 cm^{-1} TO 25900 cm^{-1}. Blinde, D. R. (Ames Lab., Iowa (USA)). Apr 1974. Contract W-7405-eng-82. 120p. Dep. NTIS $9.00.

Thesis.

The optical absorption spectra of Ho^{3+} in the rare earth salt HoF_3 is studied. Such optical region studies (visible radiation) are easily performed with standard light sources and optical arrangements. Since the energy range of visible light coincides with the excitation energy range for a number of electronic transitions within the rare earth salts, the studies theoretically provide considerable information about rare earth electronic energy levels. Data are compiled for the effects of an applied magnetic field upon the spectra and the effect of sample temperature on the observed absorption spectra. 61 references. (MCW)

31644 (LBL-2435) VIEW OF THE PRESENT STATUS AND FUTURE PROSPECTS OF HIGH-PURITY GERMANIUM. Hansen, W. L.; Haller, E. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-Eng-48. 16p. (CONF-731112-29). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

The present state of knowledge of the properties of high purity germanium is reviewed. The role of excess vacancies, oxygen and high dislocation density in producing trapping in detectors is discussed. By the application of Fourier Transform Spectroscopy, the major impurities have been identified and aluminum has been found to be the dominant one in most crystals. Analysis has shown that the principal source of aluminum is the polycrystalline starting material. The material problems related to detector fabrication are surveyed and a spectrum taken with a 43 cm^3 coaxial detector is presented. It is concluded that the important problems of material development are well delineated but that their solutions will require intensified effort. (auth)

31645 (SLA-74-6013) THEORY OF DAMAGE BY CAVITATION. Semerchan, A. A.; Vereshchagin, L. F.; Filler, F. M.; Kuzin, N. N. Translated by P. E. Newman from Inzh.-Fiz. Zh.; 3: No. 3, 87-90(Mar 1960). 7p. Dep. NTIS $4.00.

Experiments on metal (duraluminum) surfaces under the shock of a high-speed jet (water) were performed to determine the relationship between the penetration time, jet velocity, receiver volumes, angle of incidence, material eroded per unit time, and the effects of a solid jet or an intermittent flow. The theory is confirmed that cavitation damage results from repeated direct impacts of the fluid on the surface of the metal during cavitation. (MCW)

Physics

31646 (AERE-R-7338) INFRARED BURN-OUT DETECTOR. Benn, D. N.; Shock, R. A. W. (UKAEA Research Group, Harwell, Atomic Energy Research Establishment). Feb 1974. 10p. Dep. NTIS (U. S. Sales Only) $4.00. UK 50 pence.

An infra-red burn-out detector intended as a safety device for heat transfer experiments is described. Use has been made of a commercial infra-red pyrometer and a purpose-built voltage level detector and trip circuit. Details of the electronic circuit, the time response and sensitivity are given. (auth)

31647 (BDX-613-1062) SOLID STATE CIRCUIT BREAKER. Technological Spinoff Report. Elmer, E. R. (Bendix Corp., Kansas City, Mo. (USA)). Feb 1974. Contract AT(29-1)-613. 28p. Dep. NTIS $4.50.

A solid state circuit breaker was designed using the SCEPTRE circuit analysis program. The experimental circuit assembled worked satisfactorily for overloads up to 200 percent. This device would be useful in some special applications where fast operation in the microsecond range would be an advantage. (auth)

31648 (BDX-613-1081) AUTOMATIC TESTING AND HANDLING OF BEAM LEAD TRANSISTORS AND DIODES. Technological Spinoff Report. Smith, L. W.; Wilson, B. G. (Bendix Corp., Kansas City, Mo. (USA)). Mar 1974. Contract AT(29-1)-613. 16p. Dep. NTIS $4.00.

A Bendix-designed system electrical-tests all devices received in an as-etched array, moves the good devices into an expanded array, and facilitates visual inspection. The system allows economical 100-percent testing and has greatly increased quality levels in next assemblies. (auth)

31649 (BDX-613-1086) PHOTOMULTIPLIER TUBE TESTING AND ANALYSIS. Technological Spinoff Report. Bowers, J. L. (Bendix Corp., Kansas City, Mo (USA)). Feb 1974. Contract AT(29-1)-613. 28p. Dep. NTIS $4.50.

An investigation was conducted to determine the effect of a wide operational temperature range on the output of a small photomultiplier tube (PMT). This PMT is similar to the RCA 8571 miniature PMT. A calculator based instrumentation system is described including programming techniques used to reduce and display data. Also described is a Light Instrumentation System with specially designed fiber optic light guides which supplies light to the PMT to allow measurement of the PMT output with respect to temperature. (auth)

31650 (CEA-CONF-2484) SYMMETRY LOWERING OF LATTICE DEFECTS DUE TO ANHARMONIC INTERATOMIC FORCES. Sussmann, J. A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1973. 7p. (CONF-730844-7). Dep. NTIS (U. S. Sales Only) $4.00.

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973).

31651 (COO-1469-237) COLFTAR: A REAL-TIME ELECTRO-OPTICAL SYSTEM FOR TWO-DIMENSIONAL FOURIER TRANSFORMS. Sand, D. S. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Dec 1973. Contract AT(11-1)-1469. 127p. (UIUCDCS-R-73-584). Dep. NTIS $9.50.

Thesis.

An electro-optical system is described that generates optical Fourier transforms of two-dimensional video images, in real time, at standard video frame rates. This system is designated COLFTAR, which denotes "Cooled On-Line Fourier Transform and Reconstruction". The theory, construction, and operation of the system and its principal components are described in detail, with special emphasis on the resolution and modulation characteristics of the cooled-crystal electro-optic light valve (or Ardenne tube) that is the central component of the system. Several application examples are included, as well as a summary of possible improvements. (MCW)

31652 (INP-851) TEMPERATURE SPIN-WAVE RENORMALIZATION IN Cr_2O_3 AND $\alpha-Fe_2O_3$. Dimitrijevic, Z.; Kowalska, A.; Oles, A. M.; Sokalski, K.; Krygowska, M.; Moustafa, R.; Rzany, H. (Institute of Nuclear Physics, Krakow (Poland)). Sep 1973. 8p. Dep. NTIS (U. S. Sales Only) $4.00.

The spin-wave dispersion relation as a function of temperature was determined by means of neutron inelastic scattering using the diffraction technique. Magnons were observed for the [110] direction in Cr_2O_3 and [201] direction in $\alpha-Fe_2O_3$. The measurements were performed in the temperature range from 80 to 240 K for Cr_2O_3 and from 80 to 660 K for $\alpha-Fe_2O_3$. The results for Cr_2O_3 are compared with calculations performed on the basis of Bloch's and Nagaya's theories. (auth)

31653 (IS-T-593) APPARATUS FOR THE DETERMINATION OF THE COMPRESSIBILITY AND RELATED PROPERTIES OF RARE EARTH SOLUTIONS AS A FUNCTION OF TEMPERATURE, PRESSURE, AND CONCENTRATION. Manns, W. G. (Ames Lab., Iowa (USA)). Apr 1974. Contract W-7405-eng-82. 177p. Dep. NTIS $12.00.

Thesis.

An apparatus has been developed and constructed for the precise measurement of the compressibility of acidic chloride solutions. A fixed path sound velocity determination technique using an operator to determine exact pulse coincidence was used. The system provides compressibility data at any desired temperature between 2 and 75° C and at any desired pressure between atmospheric pressure and 20,000 psig. A refined geometry cell was used to avoid the reflection mode criticism of previous fixed path systems. An automatic data logging system using off-line or direct digital computer interaction is provided. This is the first part of a complete data reduction system with graphic as well as numeric output. The data analysis has been optimized for rare earth solution applications. Sample results of these data analyses for one rare earth chloride aqueous system run on the apparatus are presented. Complete data on a series of rare earth chloride solutions appears in the accompanying Ph. D. Chemistry dissertation. (auth)

31654 (KFK-1811) INTRODUCTION TO METHODS AND PROBLEMS OF RELIABILITY. Weber, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Jan 1974. 322p. (In German and English). Dep. NTIS (U. S. Sales Only) $19.25.

31655 (NIM-1582) CONSTRUCTION AND TESTING OF A PRECISION CALORIMETER. Lowe, K.; Forbes, A. W.; Marsicano, F. (National Inst. for Metallurgy, Johannesburg (South Africa)). 24 Oct 1973. 23p. Dep. NTIS (U. S. Sales Only) $4.25.

The design, construction, and calibration of a titration calorimeter capable of measuring ΔH for complete ($K \geq 10^4$) and ΔG, ΔH, and ΔS for incomplete ($10^0 \leq K \leq 10^4$) reactions in the solution phase is described. The instrument was tested by the measurement of the enthalpy change for a well-documented complete reaction—the neutralization of sodium hydroxide with hydrochloric acid. The results had a precision of 0.5% and agreed with published values. The instrument and the calculation techniques for incomplete reactions were tested by measurement of the formation constants and enthalpy changes for the reactions involved in the formation of silver(I)–pyridine complexes. The results are well within the range of values published in the literature. The calorimeter, with its automated temperature-sensing ability, is more convenient to operate than the LKB 8700 calorimetry system and gives better thermogram resolution. The instrument has been operated by a technician without any difficulty. (auth)

31656 (ORO-3443-46) SOLUTION OF INTERFACE PROBLEMS BY HOMOGENIZATION. [Part] I. Babuska, I. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Jan 1974. Contract AT(40-1)-3443. 70p. (BN-782). Dep. NTIS $6.50.

An analytical solution is derived for a self-adjoint elliptic partial differential equation. The problem was solved in the half plane assuming a Dirichlet boundary condition. (TFD)

31657 (RD/B/N-2786) TRANSPORT OF ADSORBING, RADIOACTIVE SPECIES IN A MEDIUM WITH POROUS STRUCTURE DEFINED BY A DISTRIBUTION FUNCTION. Rodliffe, R. S. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1973. 19p. (RPC/M3FPR/P-(74)2). Dep. NTIS (U. S. Sales Only) $4.00.

The transport of adsorbing, radioactive species by gaseous and surface diffusion is formulated for a porous medium described by a capillary type model with a distribution of pore sizes and orientations. The two cases considered are (1) laminar flow in the pores; transition and Knudsen diffusion effects absent; and (2) no flow in the pores; transition and Knudsen diffusion effects present. Adsorption is described by a Henry's law isotherm. Conservation equations are derived for the two cases and the resulting tensor diffusion coefficients are shown to be symmetric for arbitrary anisotropic, non-uniform porous media described by the distribution function. The analysis is applied to the simple case of an isotropic, non-uniform porous medium so that experimental results may be evaluated and theoretical predictions made from a knowledge of the pore size distribution of the material under consieration. (auth)

31658 (RFP-Trans-153) DISTRIBUTION OF DIFFRACTED LIGHT AMONG THE DIFFERENT ORDERS: ELECTROMAGNETIC INTERPRETATION AND ANALOG STUDIES AT CENTIMETER WAVELENGTHS. Stroke, G. W. Translated from Rev. Opt.; 39: No. 7-8, 351-395(1960). 42p. Dep. NTIS $5.25.

The laws were established that make it possible to predict the evolution (as a function of the wavelength and the angle of diffraction) of defects in the diffraction patterns formed by imperfect optical gratings, notably in the (general) case where the aberrant diffraction pattern for one wavelength can be established. In order to determine the distribution of the light in the ensemble of diffraction patterns formed by a grating, in the presence of arbitrary aberrations of shape and amplitude, a practical method was established of calculating the distribution of the light in the diffraction patterns based on the experimental measurement of the phase distribution in the surfaces of the diffracted waves. Agreement of calculated results and theoretical predictions makes it possible to predict the likelihood of obtaining "resolutions" with optical gratings that are considerably superior to the resolutions predicted by classical theories. It was established that the electromagnetic character of the light and the boundary conditions to be satisfied at the surface of a grating play a fundamental role in the distribution of the diffracted light among the different orders. The exact electromagnetic solution for the general case of light diffraction by a perfectly conducting grating with a sinusoidal

profile under arbitrary incidence, is given. It is shown that the waves of imaginary orders (the evanescent waves) play just as important a role as the waves of real orders in satisfying the boundary conditions. (MCW)

31659 (SLA-73-345) ANNOTATED BIBLIOGRAPHY OF SANDIA LABORATORIES PUBLICATIONS RELATED TO TERRADYNAMICS. Colp, J. L.; Caudle, W. N.; Romine, K. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 63p. Dep. NTIS $6.25.

This publication is a bibliography of unclassified reports related to Sandia Laboratories programs of terradynamics, with an abstract of the content of each listing. Terradynamics is defined as "a branch of dynamics that deals with the motion of soils and other solid materials and with the forces acting on bodies in motion relative to those materials." (TFD)

31660 (SLA-73-7003) EXACT CALCULATION OF THE PHONON-ASSISTED JUMP RATE. Emin, D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 5p. (CONF-740313-1). Dep. NTIS $4.00.

From international conference on tetrahedrally bonded amorphous semiconductors; Yorktown Heights, New York, USA (20 Mar 1974).

An exact calculation of the acoustic-phonon-assisted jump rate has been carried out. It is found that although the Miller and Abrahams jump-rate expression constitutes an adequate approximation to the jump rate in the highly restrictive situation to which they have applied it (impurity conduction between very shallow impurity states at helium temperatures), their expression does not generally provide even a qualitatively correct representation of the jump rate. Specifically, multiphonon transitions will, in many instances, provide the dominant contribution to the jump rate even as the temperature approaches absolute zero. The multiphonon jump rate will manifest a non-activated temperature-dependence, resembling an $\exp[-(T_0/T)^x]$ behavior, between helium temperatures and some fraction of the Debye temperature. In fact, the present study suggests that the non-activated temperature dependence of the electrical conductivity, which is observed in a number of non-crystalline solids in this temperature range, may arise, in the main, from the jump-rate itself rather than from the percolation aspects of hopping conduction in disordered materials. (auth)

31661 (SLA-74-82) CONTACT RESISTANCE MEASUREMENT: A DESTRUCTIVE TEST. Cuthrell, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 38p. Dep. NTIS $5.00.

A review is presented of the damage mechanisms operating on wiping and stationary electrical contacts. Destruction of thin surface films and of the metallic surface region are discussed, with particular reference to the use and testing of Sandia components. New testing procedures and equipment are proposed for evaluating, accepting, and monitoring electrical components and assemblies. (auth)

31662 (SLA-74-84) NEW 185-FOOT TOWER VERTICAL DROP CAPABILITY. Cawlfield, J. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 27p. Dep. NTIS $4.50.

A new vertical drop capability implemented on the 185-foot drop tower in Area III is described. The theoretical basis of design of the rocket-boosted payload carriage and of the constant force energy absorbers to stop the carriage is presented. (auth)

31663 (SLA-74-5073) DETONATION TRANSFER BY FLYER PLATE IMPACT. Kennedy, J. E.; Schwarz, A. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 28p. (CONF-740216-1). Dep. NTIS $3.50.

From 8th symposium on explosives and pyrotechnics; Los Angeles, California, USA (5 Feb 1974).

Detonation is often transmitted between elements in an explosive train by driving a solid plate or fragments across a gap to impact the acceptor explosive charge. An analytical model is presented that treats such transfer of detonation. Acceleration of the flyer is described by the Gurney relations. The criterion taken for initiation of the acceptor explosive is imposition of an energy fluence that must exceed some critical value. The energy fluence due to shock loading is determined by the product $p^2\tau$, where p and τ denote pressure and duration, respectively, of the shock pulse entering the explosive. It is shown how this product can be maximized within a set of system design constraints by optimal selection of the flyer material and relative thickness. When the acceptor explosive has a small column diameter, it is further required that detonation be established within a short shock travel distance into the explosive. This condition alters the optimal choice of flyer material in favor of high-impedance metals. (auth)

31664 (SLA-74-5120) SERIES-STACKED TRAPATT DIODES FOR HIGH-POWER MICROWAVE GENERATION. Liu, S. G. (RCA Labs., Princeton, N. J. (USA)). 1973. Contract 11-6604. 4p. Dep. NTIS $4.00.

For Sandia Labs., Albuquerque, N. Mex.

A compact microstrip oscillator using a three-diode stacked Trapatt device has been developed. The oscillator produces a peak power output of 1 KW at 0.5% duty cycle (average power of 5 W) with 25% efficiency at 2 GHz. (auth)

31665 (UCID-16447) ENHANCED STRESS WAVES IN SOLIDS. Wilcox, W. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Feb 1974. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

31666 (UCRL-Trans-10736) ELECTROSTATIC FIELD OF TWO TYPES OF CAPACITOR. Goehre, W. Translated from Z. Angew. Math. Mech.; 10: No. 6, 547-563(Dec 1930). 35p. Dep. NTIS $4.75.

The deflection of an electron traveling through the electric field of a capacitor is composed of the deflection caused by the part of the field considered to be homogeneous and of the deflection caused by the remaining edge. It is very important to know exactly the edge effect and to keep its magnitude as low as possible. It was suggested that two plane conductors charged to zero potential should be inserted in front of the ordinary capacitor or that an arrangement of plane conductors be chosen, the intercept lines of which with the x,y plane are shown ($v > 0$). The electrostatic fields of these two capacitors (having a dielectric constant ϵ) are analyzed. The magnitudes of the edge effects were determined and their values compared with the edge effect in a Helmholtz paper capacitor. (auth)

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